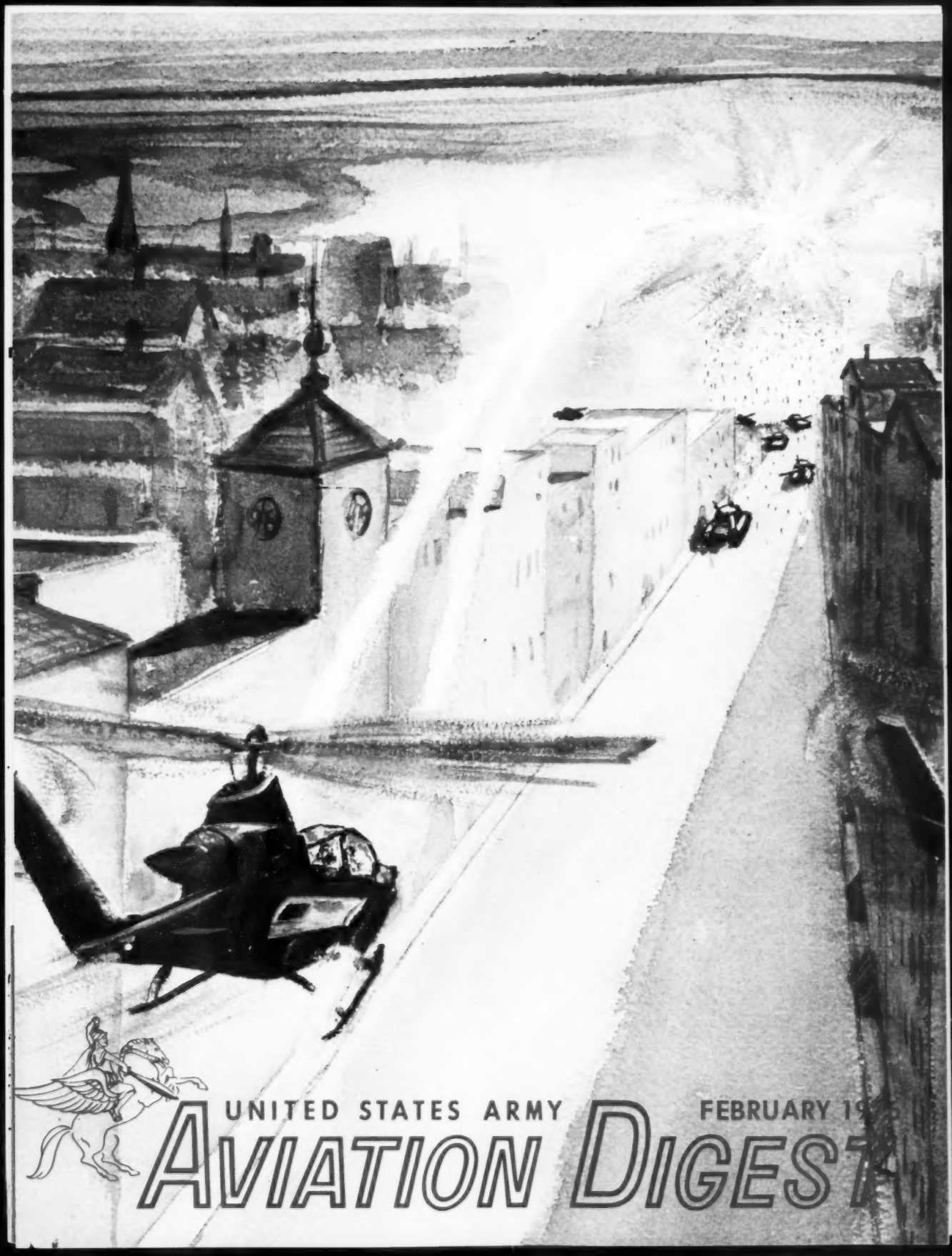
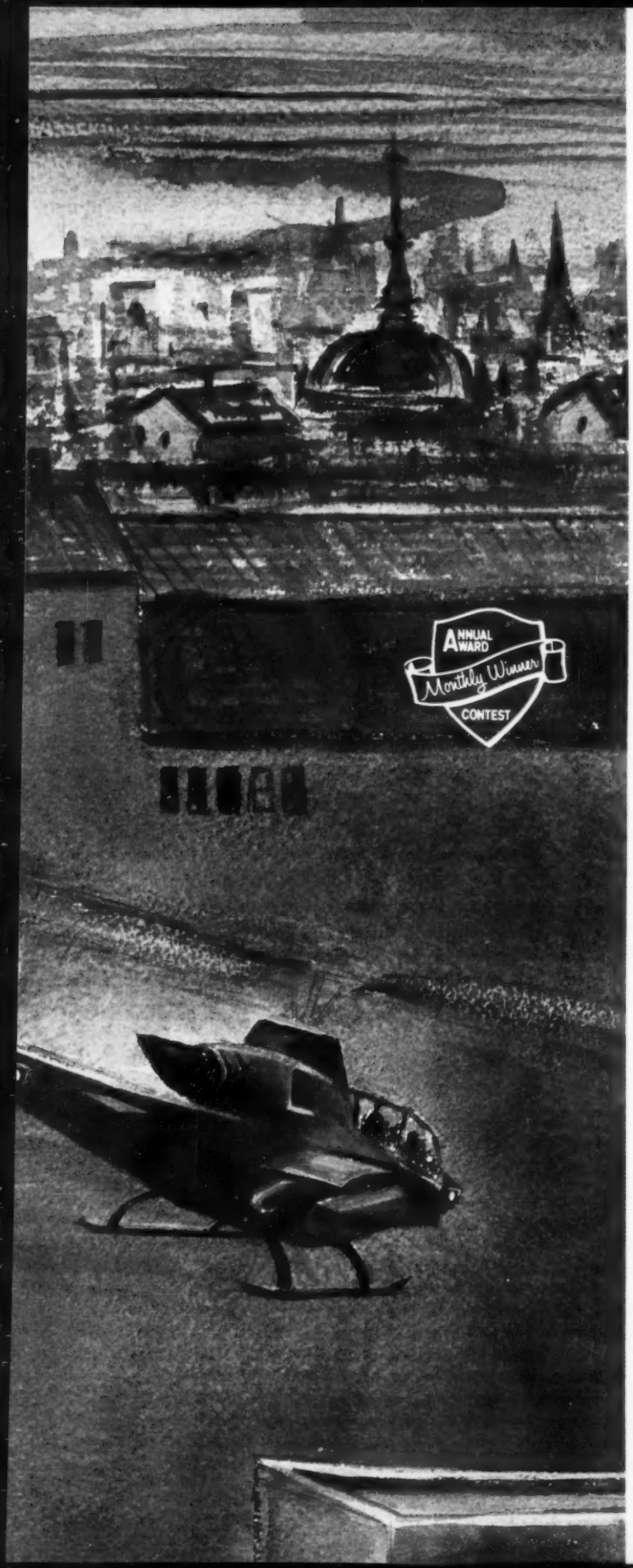


UNITED STATES ARMY

AVIATION DIGEST

FEBRUARY 19



MOBA

MILITARY OPERATIONS IN BUILT-UP AREAS

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2.75 Inch Rocket Project Office
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Advanced Research Project Agency
Office of the Secretary of Defense
Washington, DC

Can you recall an urban training area that you have seen since Vietnam villages?

Why, *what* and *how* about military operations in built-up areas (MOBA)?

Why is actually a two-headed monster. First, demographic changes in the world since World War II indicate that any future combat would involve an increased probability of U. S. involvement in urban warfare; second, the United States military corporate memory has slipped.

What—in this article—consists of a look at the characteristics of the urban battlefield and their influences on our military systems.

How includes an examination of our existing doctrine and equipment; other peoples' doctrines; and suggestions about some new thoughts concerning developments and doctrine.

To most civilians, cities consist of the things

Continued on page 2

UNITED STATES ARMY AVIATION DIGEST

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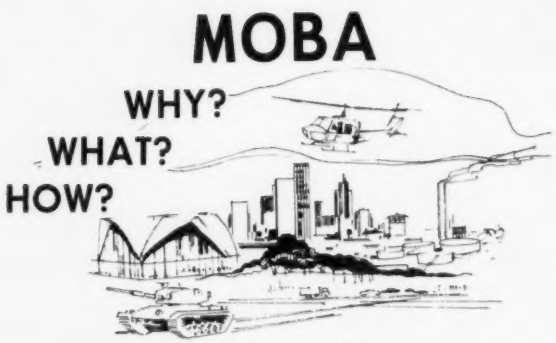


MILITARY OPERATIONS IN BUILT-UP AREAS

Continued from Inside Front Cover

pointed out in figure 1. To the military commander, however, they consist of other things—a target, a bastion or a trap.

Let us generally concentrate on the European scenario—a mid-intensity, high threat conventional war in Europe—remembering that MOBA operations span the full spectrum of conflict intensity. The name of the game in Europe is defense.

As you recall from your studies at the U. S. Army Infantry School at Fort Benning, GA, and the Command and General Staff School at Fort Leavenworth, KA, plus recent experience, U. S. doctrine is offensively oriented. Pure defense is repugnant to the U. S. military mind. If, however, the defense of Europe is our real concern, we may wish to re-examine our World War II and Asian offensively oriented doctrine for MOBA.

Turning now to the demographic facts of life, if one is living and working in the Washington area, the coastal complexes or industrial centers of the United States, the impression might be formed that the U. S. is a built-up area. However, if a person closely examines the numbers in figure 2 and then compares the size of the European continent with North America, we quickly see that North America is virtually a desert. The U.S. has an "open-country" oriented military force. We practice in the sand hills of the Carolinas, the red clay of Georgia and the dusty plains of Texas. Our experience, training and techniques are entirely oriented toward *our* perception of the world.

Focusing on Europe, if we take the Hudson Institute (Herman Kann) definition of a built-up area, the low countries are cities. However, we all know that there is extensive open terrain in the low countries. The point is that the *open terrain* of Europe is becoming a series of isolated islands, no longer contiguous. They are surrounded and dominated by the built-up areas on their fringes.

By the way, Europeans state that the criteria for a built-up area is 3,000 people per square mile, the reason being their construction methods are dif-

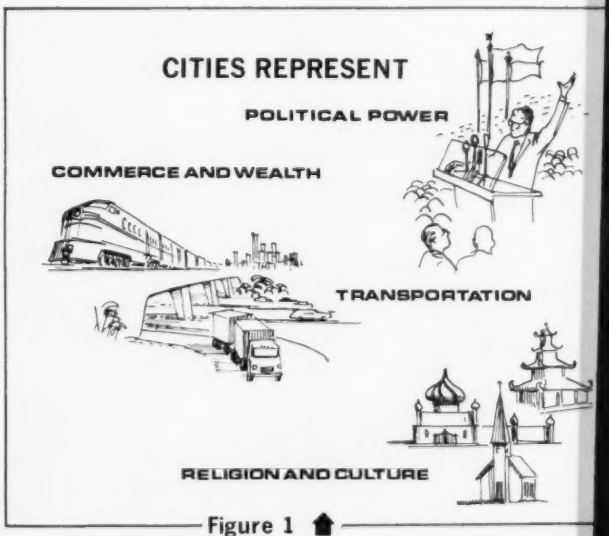


Figure 1

Figure 2

POPULATION CENTERS

	OVER 500,000 POPULATION	OVER 100.000 POPULATION
NORTH AMERICA	195	41
LATIN AMERICA	144	19
EUROPE	567	81
ASIA	463	79
AFRICA	103	10

POPULATION DENSITY

	LAND AREA THOUSANDS OF SQ. MI.	POPULATION PER SQ. MI.
CONUS	3680	60
FRANCE	211	250
WEST GERMANY	96	620
BELGIUM	12	1000
NETHERLANDS	14	1000

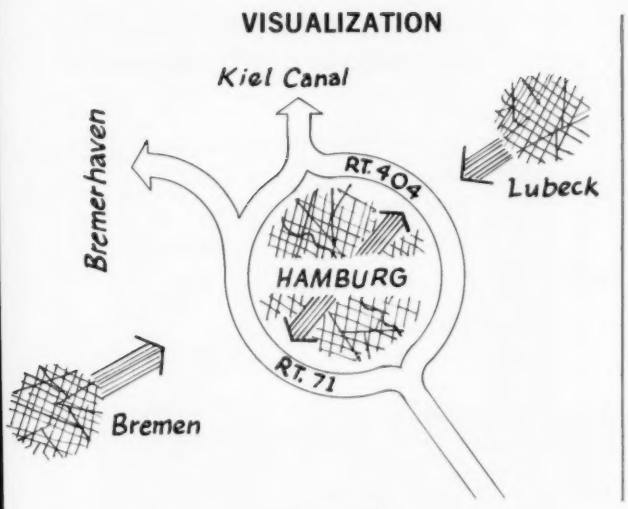
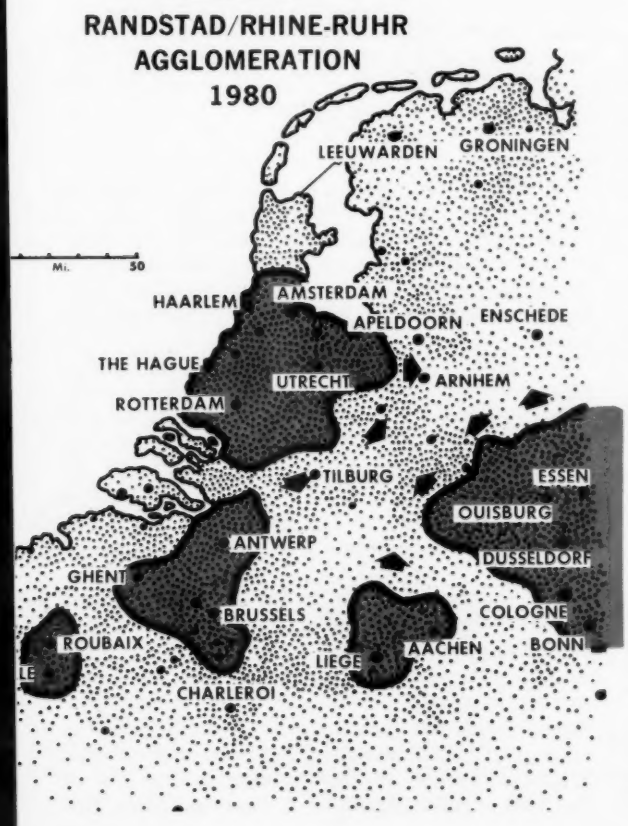


Figure 3

Figure 4

Figure 5



ferent. They tend to build multistory, multifamily dwellings and their cities have a definite edge to town. Although the U. S. Army Training and Doctrine Command, Fort Monroe, VA, recently has begun publishing an excellent unclassified series of training circulars on Soviet tactics, we still tend to believe the Soviet will do exactly what we say we would do in an offensive situation. In other words, the mirror image problem and our concept is *bypass* the town or city as visualized in figure 3 (an equally standard solution during map exercises as two up and one back).

Ask yourself, *can a large armored force afford to leave a 40-kilometer flank with two cities on each edge of that flank, providing there is a viable military force hidden somewhere in the urban complexes?*

When we look at road structures in Europe (figure 4), it is obvious there is no way to go around the major complexes without encountering numerous small built-up areas which dominate the major lines of communication. German cities, like our own, tend to be built along the main roads.

If you wish to take a look at the influence the large urban complexes have on the traditional routes of armored movement (figure 5), examine on your own a current map of the Rhine area of Germany. Note the approach to Fulda Gap down the Rhine Valley and into France. It is quite well blocked by five large urban complexes. These complexes, in conjunction with existing topography, are potentially either problems or assets in future operations.

A recent British study shows that the ring cities

of Holland and the Rhine-Ruhr cities of Germany are growing together along Autobahn 80. By 1980, the British estimate a large urban agglomeration will exist on the northern flank. The agglomerated city will be 186 miles long and roughly 66 miles deep. This agglomeration could form the basis for a formidable deterrent.

What has happened during the past 30 years since we fought across Europe in World War II? (By the way, though we did not want to, we fought through many cities in the 1940s.) Since the European cities are now larger and more numerous, it seems illogical to *not* prepare for combat in the real environment.

We have fought two wars against Asian enemies in open country. We have developed a philosophy of long-range weaponry and, to put it in a word, a philosophy of *standoff* that approaches a near phobia for guided missiles that kill tanks, but only from an unenclosed firing position. The danger of this trend is that if urban warfare is forced, *the city essentially separates the infantryman from his supporting arms.* He then will be compelled to fight with organic weapons and what he can carry on his back, supported only by fire from weapons that can be successfully employed.

There is another significant thing that has happened during the last 30 years: most of the people with urban combat experience in Europe have retired from military service. Information concerning this urban combat experience also has retired or entered the burn barrel. Those who are deeply concerned may all be assigned to the Berlin Brigade. Their training considers their "unique situation." Look around your own post, camp or station. Are there any urban training areas? An old moldy Vietnam village is all that may be found. Take a look at your yearly training highlights: mostly in the open —right?

EXISTING DOCTRINE TODAY

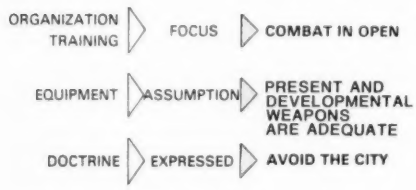


Figure 6

CHARACTERISTICS OF URBAN WARFARE

- CLOSE INFANTRY CONTACT IN CONCRETE CANYONS
- SMALL UNIT STRUGGLES FOR CAVES AND TUNNELS
- RANGES – 35 TO 50 METERS PREDOMINATE
- TARGETS – COVERED, CONCEALED, FLEETING
- DEFENDER HAS THE ADVANTAGE
- WALLS, BARRICADES, BOOBY TRAPS AND RUBBLE

Figure 7

ANTITANK WEAPONS PERFORMANCE/REQUIREMENTS

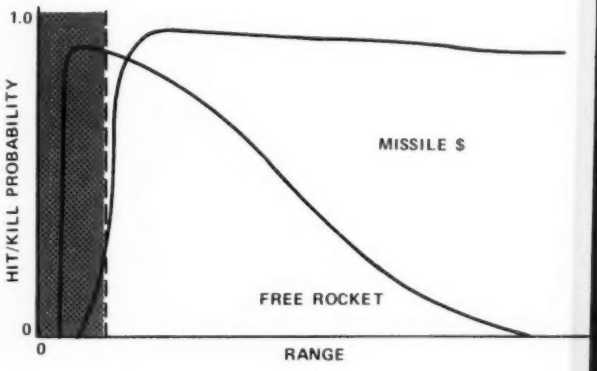


Figure 8

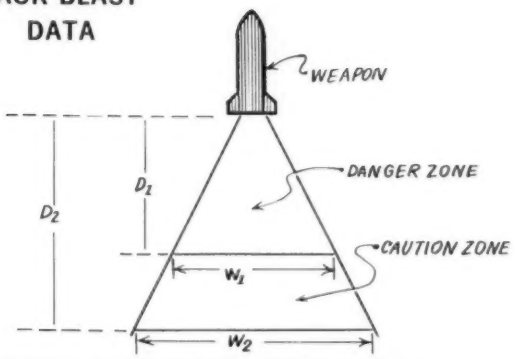
Existing U. S. doctrine is essentially as shown in figure 6: *stay out of town; it is a very nasty place to fight a war.* This may be good doctrine for offensively oriented forces when applied under the proper circumstances. However, we may wish to go back and reexamine this doctrine in the light of today's world.

In Europe, especially, there appears to be two major considerations which drive us to reexamine our current statements. First, in order to follow the doctrine, *stay out of town,* one must select an enemy who will agree to do the same thing. Secondly, especially in Europe, we should reexamine the doctrine in the light of the advantages a defender has over an attacker when incorporating an urban area into his plan.

Our friends who live in Europe have looked across the fence and come to some conclusions about the battlefield of the future.

Let's examine the Russian writings concerning combat in cities, fortified areas and forests. (The Russian considers forests, fortified and urban areas to be quite similar because of intervisibility problems.) Major General A. K. Shovkolovich, the author of the book ***Combat Action of a Motorized Rifle Bat-***

BACK BLAST DATA



WEAPON	DANGER ZONE (M)		CAUTION ZONE (M)	
	D_1	W_1	D_2	W_2
LAW	22	29	40	49
RECOILLESS RIFLE				
90MM	20	27	43	27
106 MM *	23	22	39	33
TOW	58	86	75	107
M202 ROCKET	11	18	40	49

* DRAGON IS NOT EXPECTED TO BE QUITE THIS LARGE
Source; U.S. INFANTRY SCHOOL, FT. BENNING, GEORGIA

Figure 9

talion in a City, was commandant in 1971 of the Frunze Military Academy located in Moscow for generals and senior colonels. He makes some interesting comments in the introduction to his book. He states that in any modern war in Europe, the Red Army will fight through a major urban complex every 40 to 60 kilometers.

The Soviets consider a major urban complex to be about 100,000 people. They also consider a circumference of the complex to be about 50 kilometers. What General Shovkolovich is saying, therefore, is that in future wars the Red Army will be fighting in urban areas somewhere between 15 and 25 percent of the time.

In the last 15 years, Russian writers have written more than 300 documents on combat in cities, fortified areas and forests. The Russians have built a large training area in Hungary. They have written 23 training manuals for their various branches. They deal extensively in chemical warfare and tactical nuclear warfare associated with urban combat.

The Russian general makes some interesting comments concerning tactical nuclear warfare. He says, do not drop tactical nuclear ordnance on the city. It does two detrimental things. First, it destroys the prize. Second, it dumps the city into the streets, requiring extensive clearing for armor to traverse the city.

General Shovkolovich makes a further observation —cities are barriers to armor. Therefore, airborne and helicopter-borne infantry forces will be landed in the cities ahead of the armor to clear a path so armor can drive through. This seems to tell us defense measures against such forces might provide a very high payoff. As an example of the Soviets' training performance, a series of their training manuals were examined. An East German self-defense organization training manual divided its time 20 percent each for political indoctrination; small arms firing; terrain and map reading; open country warfare and urban warfare.

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Bad News For Tanks
No author, page 35, January 1968

Germany Tests Airborne TOW
Mr. Hughie J. McInnish Jr, page 10, March 1972

1st Combat Aerial TOW Team: Helicopter vs Armor
CPT S. L. Christine, page 2, February 1974

The R & S Mystery
MAJ Thomas E. Murray II, Inside Back Cover, May 1975

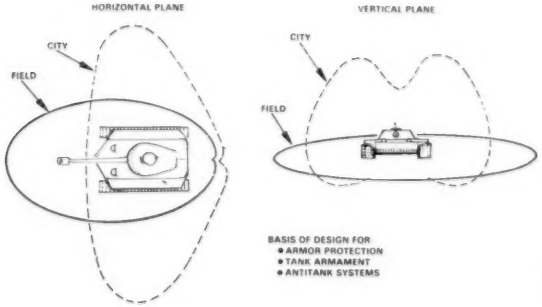
From ACCB To 6th Cavalry Brigade (Air Combat)
COL Charles E. Canedy, page 1, May 1975

Figure 11

Figure 10

ATTACK ON ARMOR

FREQUENCY DISTRIBUTION OF ANGLE OF ATTACK



the threat to air assault operations

Captain Daniel W. Henk, M.I.
Fort Huachuca, AZ

AN UNDERFLOW OF skepticism regarding the ability of air assault forces to survive the enemy mid- and high intensity (threat) combat environment is occasionally discernable within the Army community. This skepticism is understandable but scarcely justified by facts. Although simplistic answers to highly complex questions are rarely appropriate, a brief consideration of the potential threat to air assault operations may serve to clarify the issue.

In actuality, an appraisal of the threat necessarily includes more than the potential enemy. A threat is a factor or condition which may be a detriment to contemplated operations. Such a factor or condition is inherently dependent upon the characteristics of the military organization involved. Indeed, real threat in any given operation could be the inability of the friendly force to exploit opportunities offered by the enemy, weather, terrain or other relevant agencies.

This article addresses the enemy threat in general terms and is limited to the traditional intelligence interests of enemy, weather and terrain from an air assault perspective. These three factors are considered within the context of likely air assault missions. There obviously are combinations of enemy, weather and terrain which would preclude the use of air assault operations but these restrictions are no more numerous, for example, than those on armored or airborne forces.

The most specific detriment to air assault operations is the formulation of tactics by stereotype thinkers. Worse than this is the opposition to air assault concepts by "authorities" whose military orientation remains firmly planted in the 19th century. It is hoped that all potential enemies reflect this mentality, but such thinking among our planners would be a serious drawback to any commendable employment of air assault units by friendly forces.

The enemy situation is probably the key consideration in the use of the air assault force. This is true both in the assignment of its mission and in the subsequent planning and execution of that mission. There are several things which, due to their potential impact on air assault operations, must be known about the enemy situation—the first obviously being his air defense capabilities. Other information in the same category includes enemy air (including air attack, airborne and airmobile) capabilities, nuclear capabilities, and his ability to attack or reinforce the attack at landing zones and prospective friendly locations in the objective area.

Responsibility for a detailed knowledge and continual assessment of the enemy threat necessarily accrues to a unit's intelligence staff. In keeping the commander (and subordinate intelligence staffs) adequately abreast of the enemy threat, the intelligence officer in the air assault force must be able to progress coherently in his analysis from enemy capabilities to probable enemy courses of action. It is in the latter category that enemy vulnerabilities are identified for possible exploitation.

It should be noted that an understanding of enemy vulnerabilities in air assault terms necessarily relates terrain and weather to the enemy situation. In terms of the enemy's conventional ground capabilities, relative mobility is usually the most exploitable feature. In terms of the enemy's air defense capabilities—suppression, terrain and weather become critical factors in mitigating the threat. This is fairly evident based upon even a superficial knowledge of current weapons systems.

A new generation of surface-to-air missiles has severely challenged high performance military aircraft on the battlefield. But these systems have yet to pose a clearly defineable threat to aircraft at low level altitudes likely to be used by air assault forces.

A type of weapon system which has received some recent publicity is the shoulder launched surface-to-air missile represented by the

This article was researched and written by Captain Henk during his assignment to the Assistant Chief of Staff, G-2, the 101st Airborne Division (Air Assault)

I have read "The Threat To Air Assault Operations" with the view of technical accuracy and compatibility of this article with current/planned policies and programs. I find that it is technically accurate and is compatible with such policies and programs. I further find that it is quite current with what we are doing here in the 101st Airborne Division at this time and recommend its publication.

Major General John W. McEnery
Commander
101st Airborne Division (Air Assault)

U. S. "REDEYE" and Soviet SA-7. These missiles present a threat to aircraft at low altitude (below 13,000 feet) on the battlefield, and thus will be a definite threat to air assault operations. On the other hand, successful use of these weapons is limited by several factors. First, the infrared homing and even more sophisticated tracking devices are all susceptible to innovative countermeasures. The missile's effective minimum range also can be underflown.

The chief drawback to use of these missiles is the operator who must visually acquire and identify targets—usually without substantial warning. He must then aim the missile, lock onto the target and fire. If there were some questions of aircraft identity (as certainly would be the case on a high threat battlefield) or if the aerial target were visible for brief periods only, due to its low altitude, the missile would be at a serious disadvantage. Periods of darkness and low visibility also would impair the effectiveness of the gunner's visual identification of the target.

Electronic acquisition and fire control equipment accompanies the more sophisticated tube air defense artillery systems. Modern Soviet weapons in this category include the S-60 (57 mm towed gun) and the ZSU-23-4 (23 mm quad-mount, self-propelled gun). The former is designed primarily for use against high performance aircraft at low and medium altitudes. The latter is intended as an efficient opponent to aircraft at low altitudes (up to about 9,000 feet). These systems, and others that are similar, are a significant threat to rotary wing aircraft at normal altitudes and under most weather conditions. Poor visibility does not degrade the systems.

These systems do have features which can be exploited. First, the electronic equipment always will be vulnerable (in varying degrees) to electronic warfare (EW). If these weapons are forced by offensive EW to acquire and track aerial targets mechanically, the effectiveness of the system will depend on visual capabilities of the human crew and be entirely at the mercy of relative visibility. A second feature is the inability of the electronic equipment to penetrate topographic features. Aerial targets at very low altitudes also gain some protection from electronic targeting due to "ground clutter." This phenomenon seriously inhibits the retention of a clear target by acquisition and tracking equipment.

A third exploitable feature is

Continued on page 16

The Soviet SA-7 "Grail" and United States Redeye missiles are a threat to low flying aircraft (photo) on the battlefield

U.S. ARMY AVIATION CENTER

TACTICS LABORATORY

Captain Charles E. Taylor
Tactics Branch
Department of Academic Training
Deputy for Training
U.S. Army Aviation Center

A New Concept in Tactics Training for Army Aviators

ONE HOT SUMMER day at a meeting called "Show And Tell," Major "P" was asked, "What are you people in tactics doing?" Then Major "P" dropped the bomb: "Sir," he replied, "we are working on a new concept in tactics training for Army aviators."

I have just concluded my research and have identified the major student weaknesses in nap-of-the-earth (NOE) flying; target identification; tactical communication procedures; basic tactics and tactical aircraft loads."

From this grand awakening came the spark that spawned the idea for a new concept in aviation tactics training: The U. S. Army Aviation Center with its *Tactics Laboratory*.

The mission of the Tactics Laboratory is to provide the students with a working knowledge (hands-on-training) of aviation tactics, emphasizing techniques of planning and executing an aviation mission which may be assigned to Army aviators. It is believed that new Army aviators will be proficient in tactical procedures necessary to conduct combat operations without the lengthy unit training that was required in the past.

The Aviation Center Tactics Laboratory puts a man in a tactical environment so that he will be on familiar turf in the field. Learning is increased because the student aviator is not exposed to the dangers of actual flight during this type of training; and, in the classroom environment he has the capability to repeat training if necessary. When the student gets to the flight line he has only to apply what he has learned.

In the Tactics Laboratory, student involvement with unique training aids is *the thing* which provides the realism so necessary in today's training programs. This realism is achieved by the use of devices that were mere dreams five years ago. Training aids are perfected as closely to the actual field training as possible.

Housed in the Tactics Laboratory is the NOE flight trainer (figures 1, 2 and 3). This is a static training device consisting of the front portion (just forward of the cargo door) of the UH-1. The trainer seats two students and has a panoramic screen (parabolic type which gives each student a view to the front and about 90 degrees to each side).

An instructor's console gives the instructor the capability to introduce aircraft emergency problems into the system. This enhances a student's ability to react to emergencies while performing simulated NOE flight, i.e., engine failures and hydraulics malfunction.

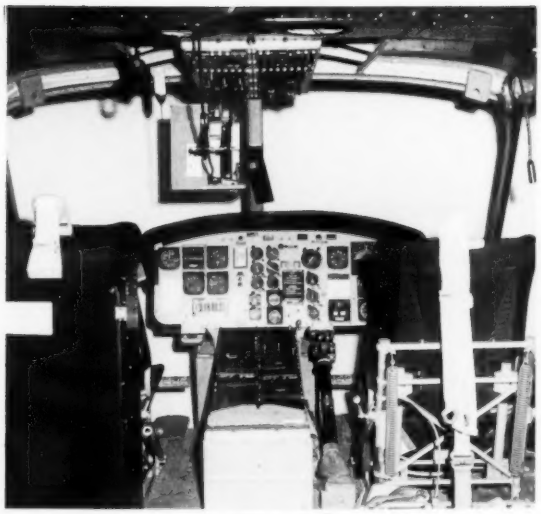


Figure 1

Prior to starting the engine the student is given a briefing on the tactical situation. He must then conduct his mission planning, applying the principles taught in the classroom. He cranks up the aircraft and is ready to proceed on the mission. But, at this point the student has encountered much more Tactics Laboratory training than we have discussed so far. Before he ever "stepped into" the NOE training, he developed a feeling for target identification, tactical communication procedures, basic tactics, tactical loads and crew/passenger briefing.

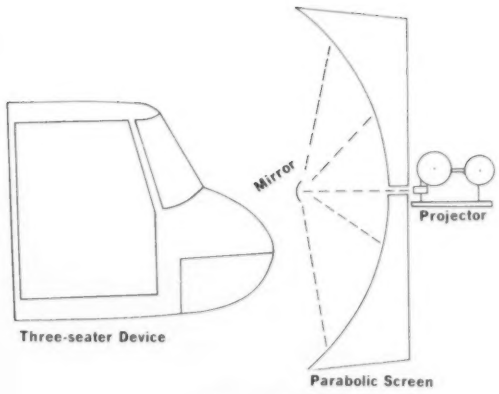


Figure 3

Target identification, using conventional instructional materials, had many limitations. The major limitation was that the materials available were not suitable for demonstrating the difficulty in low light conditions. The absence of color and movement prevented the instructor from using the effect of color contrast or the effect of diminution of detail with increase in range—and conversely, the appearance of detail with decrease in range. Students rarely saw the object to be acquired or recognized other than the front, rear or side views.

Well! That was in the past. We have gone to the third dimension—a terrain board—which depicts tactical situations and hardware from throughout the world. The lighting on the terrain board can be varied from early morning to night (figure 4). Looking through binoculars from the bleachers, the models

Figure 2

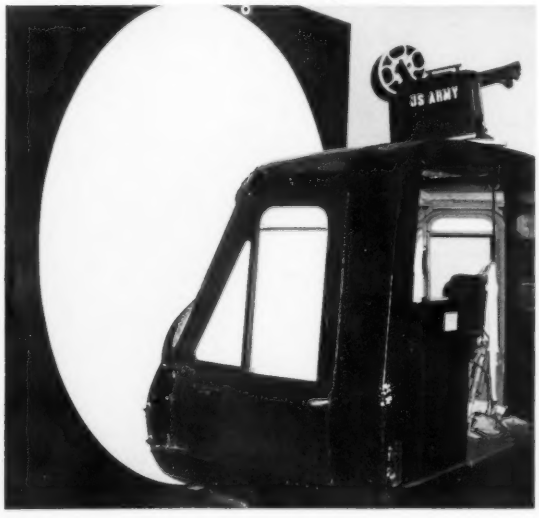


Figure 4

are about 750 to 1,000 meters (figure 5). The models must be manually moved by the instructor; however, plans call for electrically operated models which will move about the terrain board, giving the student about 10 seconds to acquire and identify the target.

The Aviation Center is considering extending this training to the flight line by having life-size mockups of targets situated along an NOE course. The student would be required to detect, identify and record the locations of these mockups within specified time limitations.

Tactical communication procedures utilize the facilities outlined in figure 6. The student will be able to set up frequency modulated (FM) radios for retransmission using organic aircraft radios to extend the radio transmission range; FM homing; secure voice procedures using the KY-28 (cryptographic scrambler) and the formulation of radio messages when given tactical situations. Electronic warfare will be conducted concurrently throughout communication training. Figures 7 and 8 depict long-range plans for individual student communication consoles.

Tactical loading (figure 9) shows the student formal as well as informal methods of loading rotary wing aircraft. It also stresses the right and wrong ways to tie down cargo. Figure 9 happens to be the *wrong* way.

Basic tactics are taught using a terrain board of specific areas to include desert, tropical or mountainous terrain. The students are seated in an amphitheater type seat. Using the appropriate scenario the instructor will teach basic tactics, employment of

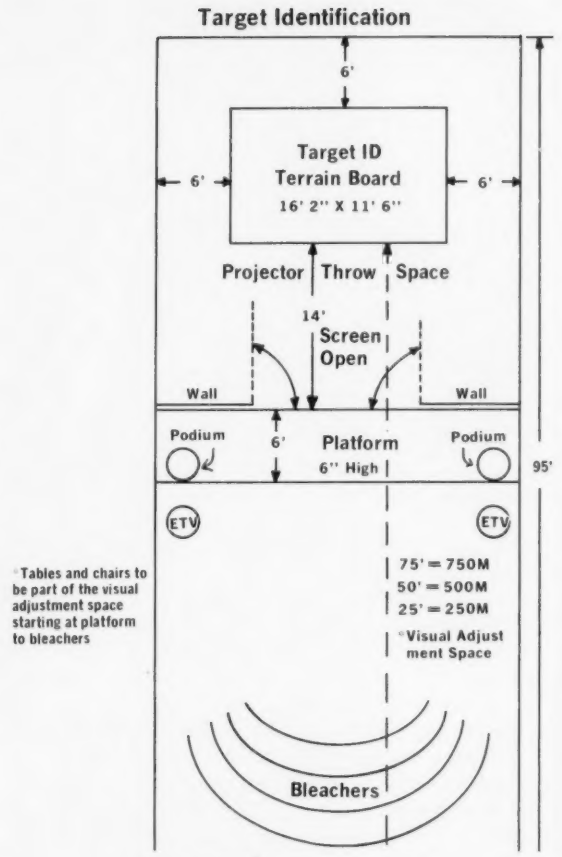


Figure 5

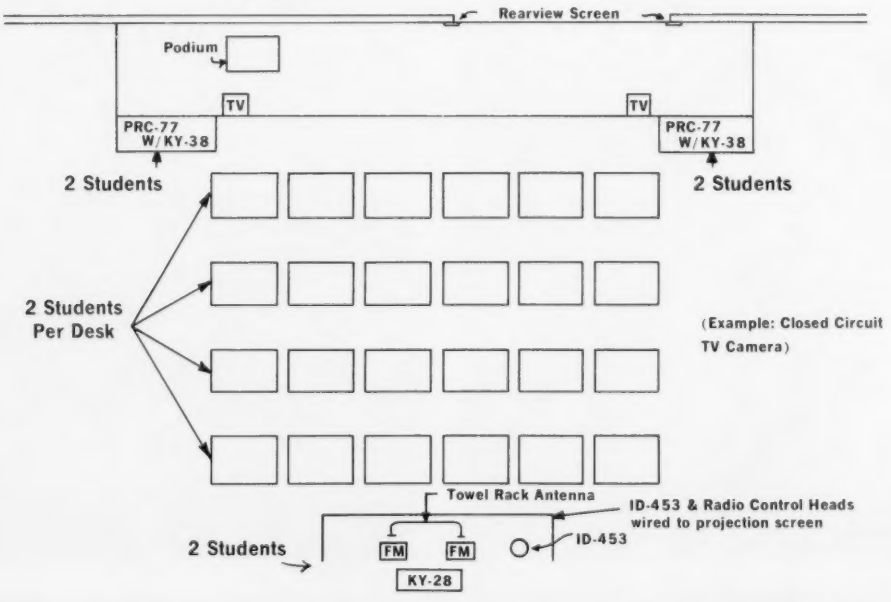
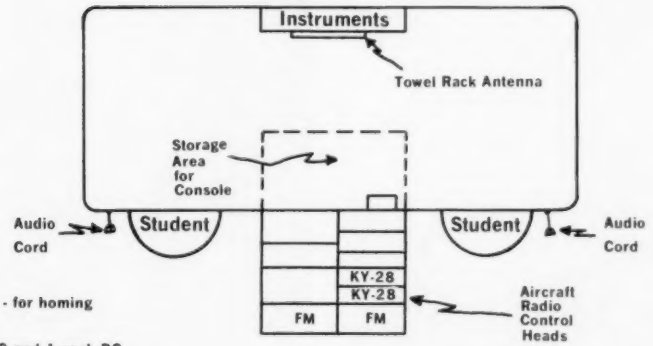


Figure 6

Type Communication Procedure Console

(Long Range Plans)



Not To Scale

Instruments

ID-453 or ID-1351A - for homing

Ammeter (DC)

Voltmeter - 1 each AC and 1 each DC

Figure 7

Figure 8

Commo Classroom

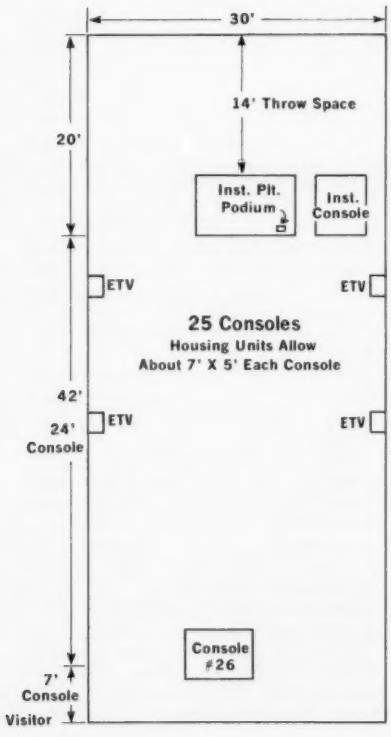


Figure 9

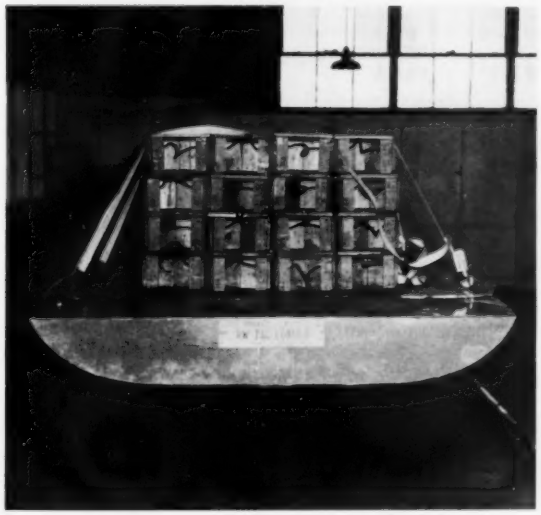
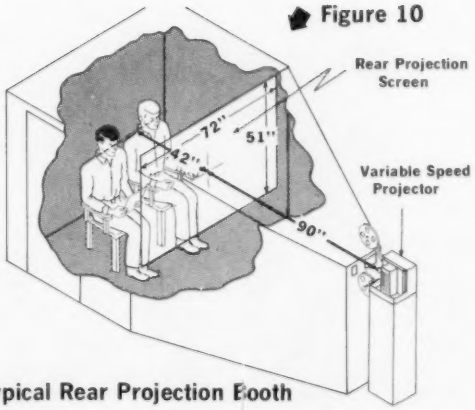


Figure 10



Typical Rear Projection Booth

Figure 11

Figure 12

Army aviation camouflage and concealment and the laws of land and warfare.

In addition to the NOE trainer and terrain board the Tactics Laboratory also has booths (figures 10 and 11) in which the student learns to correlate the terrain features on a map with the moving picture shown on the rear projection screen.

The M-22 wire-guided, antitank missile system (figure 12) is a training device for developing the hand and eye coordination required for accurately firing the M-22 and will be used in conjunction with target ID (identification) terrain board.

The previously mentioned innovations are only a few of the happenings taking place in the Tactics Laboratory. The Tactics Laboratory started as a dream and the evolution of this dream is the culmination of the real helicopter pilot—the Army aviator, the man that is both tactically and technically proficient! Don't believe me, ask any Army aviator.

U-6s Vanishing

The last vestiges of an era of Army aviation will vanish when the Berlin Brigade Aviation Detachment delivers its two U-6A aircraft to Coleman Barracks, Mannheim, Germany.

The U-6As, two of possibly only four left in the Army, are being phased out in favor of more sophisticated aircraft.

Built by DeHavilland, a Canadian aircraft company, the U-6A was designed to carry a pilot and five passengers. They were originally referred to as L-20 "Beavers." In the late 1950s and early 1960s, there were about 650 U-6s being used by the Army. Indispensable in courier and messenger service, the "Beavers" also were used for light cargo, supply dropping, medical evacuation, reconnaissance and camouflage inspecting.

Continued from page 5

In another manual for mechanized units, a 390-hour syllabus devotes about 60 hours of the armor time and 25 hours of the selfpropelled gun time concentrated on action in urban areas. The Russian, therefore, is allocating his training money and time to urban combat.

The characteristics of urban battlefields are listed in figure 7. It has always been a small unit struggle of infantry at very close range. As was said earlier, a city effectively separates infantry from supporting arms. If you consider visibility restrictions and realize that the enemy is normally less than 100 meters away, it is readily apparent that close air support, artillery and munitions as we know them today would have a kill probability of two—you and the bad guy.

Since the struggle is one of small units, if the enemy can constantly beat you at the squad and platoon level, he eventually will beat you at the division level. It behooves us then to go back and review our doctrine, training and tactics. We may find that our equipment is so designed for the open country that it will not function or, at a minimum, be degraded in the urban environment of Europe.

Let's first examine some of the infantry weapons. At the city fighting ranges, the penetration of the M-16 rifle into building materials is slightly higher than the 45-caliber pistol. We have in the hands of our troops a very good "varmint" rifle. The question is "does this weapon have a place in the close ranges of urban warfare?"

The real kicker is the performance of infantry organic-antitank weapons. Historically, the recoilless rifle has exhibited very poor performance against moving targets at ranges beyond 500 meters. Therefore, we asked the missileers to jack up the 1,000-meter end of the curve. We have very good infantry missiles with a high hit probability at long ranges. There are, however, some drawbacks to these systems for the urban battle. First, it is expensive. Will you shoot at its secondary targets? Second, it is heavy, so only a few are carried. And third, at minimum range, arming and system tracking capabilities are questionable. If the gray area on the graph in figure 8 is greater than one-half a city block, we will have serious employment problems. (By the way, the Russian Sagger missile is much worse in minimum range performance.)

Our greatest weaknesses are yet to come! Note the blast data in figure 9. We do not have an infantry antitank weapon that can be fired from inside a room. All of our weapons must be fired with large clear areas to the rear. Precision weapons require that we remain exposed (line of sight) to fly them to the target. In the close ranges of the city, these requirements generate the need for an extremely brave firing crew.

Are these limitations peculiar to the infantry antitank weapons? Putting the TOW (tube-launched, optically-tracked, wire-guided) on an attack helicopter merely places it on another firing platform of greater capability. Agility is a most important system capability when compared to the infantry TOW. Being on the wrong side of the block may be very difficult to correct on the ground. But an attack helicopter can apply firepower at any place due to a large radius of action and speed. However, minimum engagement ranges and time of flight remain a common constraint.

What about the even more sophisticated missiles

Development Of A 2.75 Inch Rocket Pod
No author, page 7, April 1962

Aerial Rocket Artillery
MAJ Warren E. Mullen, page 18, December 1968

Attack Helicopter Pilots Atten--HUT!
CPT Milton J. Brokaw, page 24, October 1969

The SHOTGUN Is Here
LTC George L. O'Grady, page 10, April 1975

SEAS/COEA
MAJ David J. Antonoplos, page 14, April 1975

Zee Egg Versus Zee Tank
COL Frank P. "Rags" Ragano, page 24, May 1975

The Air Combat Directorate, Headquarters, MASSTER
COL Daniel B. Knight, page 6, July 1975

Smoke — Who Needs It?
CPT Leland L. Huber and LTC Jesse E. Felter, page 1, September 1975

MOD-Y Test By 101st
CW2 Donald R. McCoy, page 4, September 1975

Chaff: Its Use, Its Effect
Deputy for Developments and LTC Porter B. Dillon, pages 25 & 26, September 1975

Big Flare With Rocket To Go
Mr. Jack R. Still, page 8, December 1975

Figure 12

in development, how will HELLFIRE (helicopter launched fire and forget) or cannon launched guided projectiles perform? The target must be designated by someone and the missile must acquire or lock on, both on a line-of-sight basis. There also must be communication with the launcher whether on a helicopter or in a 155 battery.

Current helicopter UHF (ultra high frequency) radios can be blocked from tower reception by a metal hangar at ranges of a couple of hundred meters and FM (frequency modulated) radio is worse. We know a lot about communications systems of fire departments, taxicabs and the police. They have three things going for them: (1) high power central transmitter; (2) relays on tall buildings; and (3) if they cannot gain communications, they merely drive up and down the street until they can communicate. The platoon commander in the basement of a parking garage or a precision laser designator team operating from a hotel window may have none of these options.

Consider the flight path of the missile. If the launcher is at a considerable *standoff* and is not aligned down the axis of the street in which the target is located, maybe it just cannot get there, let alone lock on without striking an intervening building.

Artillery is to be employed in direct fire. What fuzing and round combination lend themselves best to the built-up area? Proximity, point detonating, variable time on the warheads—these will at best tear up the building exterior or blast through after repeated hits. Delay fuzing contributes the most lethality; however, with fixed times, there is little variability for selection of the proper setting for the penetration conditions at hand.

Consider the picture (figure 10) of the way tanks die. It is a cartiod distribution curve, recently reaffirmed in the Mideast. Tanks in the open are killed by other tanks or other antitank weapons to their front. Therefore, tanks are heavily armored to the front. In the city the distribution has often changed. Unsophisticated weapons are in the hands of poorly trained persons or rear echelon troops ambushing armor from the sides and the top.

Desirable characteristics for the attack helicopter weapons for urban combat are a short minimum range; minimum engagement and return to cover time; and unassisted fire and forget capability. Other interesting features might be indirect fire at relatively short ranges of one to three city blocks and the capability to selectively move warhead effects *within* a building.

During operations in built-up areas, the attack helicopter will be fighting in conjunction with scouts and other aircraft in support of the ground commander. Its weapon systems will include the TOWs, automatic cannons, 2.75 inch rockets and machineguns.

The TOW will be used to kill hard point targets (armor) while the 2.75 inch rocket and automatic cannons provide suppressive fire along with the machineguns.

For more detailed information concerning the TOW missiles and 2.75 inch rockets—and their employment—see the bibliographies in figures 11 and 12. Copies of these articles are available upon request. Also see "Remote Set Fuzing for the 2.75 Inch Rocket" coming in the April 1976 ***DIGEST***.

The automatic cannon's greatest contribution may not be directly attributed to the level of effectiveness—such as fraction of personnel casualties, or destruction of light materiel/armor, but more probably to quick reaction with off-axis employment. The attack helicopter with a cannon can effectively provide a level of self support (suppression/neutralization) while the more lethal TOW or 2.75 inch rocket submunitions are being fired. (For more on automatic cannons see "The Up-Gun Dilemma," page 8 of the May 1975 ***DIGEST*** and "If Bullets Could Talk," page 2 of the September 1975 ***DIGEST***.)

There are advantages to the city's labyrinths of canyons: they offer cover and concealment to friendly elements and efficiently channelize enemy forces. A good sensor and surveillance system with effective communications might allow a small number of airmobile forces equipped with effective weapons to defend a large urban area.

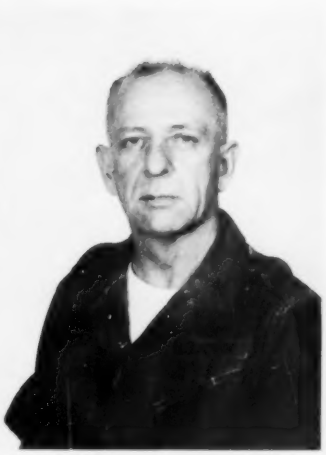
The helicopter also will be effective in helping to defeat enemy small arms fire, which can be liberally scattered throughout the city. Working with attack helicopters, the assault helicopters will enter the city at extremely low levels with door gunners aiding in the suppression of small arms fire. They will deliver infantry to rooftops and resupply the troops by landing on rooftops or in clear areas. After sunset, helicopter operations continue with helicopter pilots trained to fly and fight at night. Night vision devices and illumination provided by helicopters or artillery will supplement these operations (see FM 90-1).

There will be many interesting developments that can contribute to the combat effectiveness of our forces in built-up areas if the need is recognized. The development community can meet the challenge. How might we ensure that the infantryman, who will ultimately be charged with the mission of MOBA, gets the weapons and fire support he needs? We must have a place in our requirements document that—in addition to specifying "Icing Conditions Category 6"—would have "Terrain Conditions Category MOBA."

J. Elmore Swenson . . .

as a combat Liaison Pilot

as a DA personnel specialist



as 10th Group commander

ARMY AVIATION HALL OF FAME

MAJOR J. Elmore Swenson was a World War II Army aviation combat veteran; an aviation personnel specialist within the Department of the Army (DA); one of the organizers of the U.S. Army Aviation School both at Ft. Sill and later at Ft. Rucker; and commanded the 10th Aviation Group which as the 10th Air Transport Brigade supported the 11th Air Assault Division.

Major Swenson entered the aviation program as a member of the Army's first flight class at Fort Sill, OK, in 1942. One of the first Liaison Pilots to be sent overseas, he exploited the tactical use of Army aviation to the fullest as Division Artillery Air Officer, 29th Infantry Division. Leading his "29th Air Force," as he called his air section, Major Swenson directed one of the first fire missions on Omaha Beach on "D" Day. He participated in all of the European Theater of Operations' major battles from Normandy to campaigns throughout France, Holland, Belgium and Germany to VE (victory in Europe) Day.

Major Swenson was qualified as one of the Army's first helicopter pilots while serving as Fifth Army Air Officer in 1946. In mid-1948, he was assigned to DA as Aviation Officer, Career Management Division. At that time only 425 Liaison Pilots were on active duty, and the chance for survival of the Army aviation program was bleak.

Through astute staff work, personal expertise and salesmanship, Major Swenson was able to establish a revitalized Army aviation program which included aviator authorizations within all combat arms and also in several of the technical services.

His staff work served as the basis for the present Aviation Career Management System, and included a plan for periods of ground duty to keep the aviator branch qualified, then as now, and competitive with his nonflying contemporaries. Major Swenson was responsible for the design and adoption of the present insignia for Army aviation wings, and the establishment of the present Aviator Rating System providing Aviator, Senior Army Aviator and Master Army Aviator professional levels.

As 10th Group commander, Colonel Swenson helped develop airmobile support procedures and doctrine used today.

Colonel J. Elmore Swenson retired in 1971 after nearly 30 years of service as an Army aviator. A Master Army Aviator, he died in early 1972, a few months after his retirement.

threat

Continued from page 7

the ground mobility of the electronically equipped air defense gun systems. Assuming (and this is a valid consideration except in unusual cases) that the enemy will not have sufficient air defense guns to cover every conceivable avenue of approach into his positions, he must depend upon some degree of mobility for his all-weather air defense systems. The tracked chassis of systems like the self-propelled ZSU-23-4 provides substantial ground mobility but not absolute mobility. (Next month see, "Self-Propelled Antiaircraft Gun—The ZSU-23-4.")

It is readily obvious that some terrain will virtually prohibit vehicular ground movement and that trafficability is a continuing factor in any ground movement. This means that air routes to objective areas (and the actual objective areas) can be determined to take maximum advantage of enemy ground mobility restrictions.

A fourth exploitable feature of electronically equipped air defense guns is their "signature" which betrays their identity and location. The moment electronic air defense equipment on the battlefield begins to operate, its unique electronic profile is subject to being intercepted, identified and located by friendly intelligence collection means, thus providing the option of avoiding or destroying the known sites.

A final category of air defense weaponry to be considered is the small caliber, rapid firing, optically-sighted (usually) multi-barreled antiaircraft gun. Calibers of weapons in this category go up to about 57 mm. The Soviet representatives are of 12.7 mm, 14.5 mm, 23 mm, 37 mm and 57 mm. Of these, the 14.5 mm and 23 mm seem destined for widespread manufacture and use. The 12.7 and 14.5 mm guns are found in numerous configurations and used in both an antiaircraft and direct-fire ground role. (It is important

On-carriage radar fire control is one feature of the ZSU-23-4. Guns are liquid cooled quad version of 23 mm automatic ZU-23 (see page 18)

Widely used ZPU-4 is a 14.5 mm quad heavy machine-gun that is very effective against low altitude aircraft

that these optically-sighted weapons not be confused with the radar equipped systems such as the Soviet ZSU-23-4.)

The optically-sighted weapons are effective against low altitude aircraft and will probably form the bulk of the threat against air assault operations. This is not because of inherent superiority as air defense systems but simply because they are the most numerous and widely distributed air defense weapons on any battlefield. These systems depend upon visual target acquisition, visual identification of friend or foe (IFF) and mechanical-optical ranging. Obviously they are limited by their human operators. If visibility precludes target acquisition (or even identification) the resultant efficiency of the system is degraded. If the aerial targets can take such advantage of terrain as to be visible for brief periods only, the systems are further degraded. (Informal, unofficial experimentation in the 101st Airborne Division (Air Assault) has adequately verified the latter observation.) The same general things apply to small arms fire used in an air defense role, except that to be a significant factor small arms must be massed, carefully controlled and employed by well trained personnel.

Since enemy "air" was not a consideration in ground operations in the Republic of Vietnam, the enemy could assume that all aircraft were hostile. This greatly simplified a critical feature of enemy air defense operations—IFF. Opinions regarding the effectiveness of air defense weapons systems should be tempered by this fact if Vietnam is used as the basis for the opinion.

Of course in a high threat combat environment enemy air may be a definite factor in the air defense operations of both sides. To the casual observer rotary wing aircraft may appear to be at a disadvantage matched against high-performance aircraft, but proper use of air assault flight techniques more than compensates for any seeming disparity. Very few high-performance aircraft are intended for highly maneuverable air-to-air combat at nap-of-the-earth altitudes. Both the high speed and the relative immaneuverability of high-performance aircraft are serious disadvantages in this case. Additionally, "down-looking" air-to-air missile fire conducted by high-performance aircraft at low altitude is not likely to be exceedingly effective. In fact, cannon fire and air-to-air missiles employed by the rotary wing aircraft probably would be far more satisfactory in such a situation.

The whole point of this diversion into air defense weapons systems is to illustrate the fact that weather/climatology and terrain/altitude can be exploited to derive maximum protection from any combination of air defense systems. Exactly what can be best exploited at the most appropriate time is exactly the determination which the air assault intelligence officer is constantly seeking.

Although enemy air defense capabilities are merely the first part of the enemy threat, they are of continuing significance. The air assault force depends upon aircraft to arrive in the objective area and to continue air assault operations indefinitely from any operating base. Aircraft can be expected to provide all logistic support for significant periods of time and substantial logistic support at all times. Even more critical during certain phases of air assault operations is the fact that some or all fire support will be provided by Army units or Air Force aircraft. This is especially significant in that the organic field artillery of the air assault division—the 105 mm howitzer—is outranged by its modern Soviet equivalent—the 122 mm howitzer (D-30). If enemy air defense operations can deny this friendly logistic and fire support, the sustainability of air assault operations may be subjected to some question. Enemy air defense may be circumvented, *but it can never be ignored.*

Other aspects of the enemy situation are also closely tied to terrain and weather considerations. The threat has significant bearing on the constitution of key terrain. Although the same key terrain is often identified as such by both enemy and friendly forces, the air assault force has a number of

unique criteria for its selection.

From the air assault point of view, objective areas (as key terrain) must afford certain advantages. For one, the objective area must be accessible to rotary wing aircraft by being within a determined range of contemplated air assault operations and by offering reasonable landing zones. The range is the absolute length of the primary and alternate air routes into the objective area. The air routes themselves are a function of which avenues to the objective area provide maximum protection from enemy observation and fire, minimum distance to the objective area and maximum aid to navigation enroute.

Another advantage the chosen objective area must afford is securable and defensible terrain. This means that the enemy situation at the objective cannot preclude securing the objective, and that once secured the friendly forces at the objective can effectively oppose a counterattack. (This consideration also reflects the relative ability to extract air assault forces when the enemy situation warrants that course of action.)

A third advantage offered by the selected objective area must be that it is designed to facilitate the overall air assault force mission. This consideration is both relative and absolute—relative in that the friendly force must survive in order to complete its mission—absolute in that the continued possession of the objective may be the actual mission or may allow establishment of the operating base essential to accomplish the mission.

While it is obvious that the enemy situation must be known to calculate the advantages of one objective or another, the terrain and weather considerations are less obvious but equally important. Hours of darkness (or poor visibility) could make an otherwise unsuspicious location ideal for the air assault objective. By the same token, several days of rain could so affect trafficability that a selected air assault objective could be relatively invulnerable to approach by enemy ground vehicles. Clearly, geography and climatology can be major allies to an air assault force and major arbiters in the decision of what is key terrain.

The detrimental effect of certain terrain and climatological conditions upon air assault operations must be mentioned. The same poor visibility affording protection from enemy air defenses also may seriously affect navigation. Density altitude at given times during the day (or year) may impose drastic weight restrictions upon lift assets. The inclement weather which halted the enemy's armor also may ground friendly aircraft or (worse yet) preclude aerial fire support. Terrain and weather are as integral to the overall threat as the enemy situation. But, they are equally amenable to exploitation.

It should be evident that the intelligence officer has a significant function in air assault planning. The usefulness, perhaps even the entire survivability, of the air assault force is predicated upon the timely acquisition, accurate analysis, adequate dissemination and proper exploitation of intelligence.

The need for intelligence is as fundamental to a successful air assault operation as the need for fuel, and generates at least the same level of planning activity. The rapid acquisition and exploitation of intelligence is fundamental to the survivability of the air assault force, but more importantly, is possibly the true rationale for the existence of the force at all.

If the available intelligence structure is adequately employed in the air assault force, and if the exploitable features of the overall threat are thoroughly reflected in its operations, air assault can be a devastatingly effective weapon in virtually any contingency environment.

Another significant threat is the ZU-23, a light towed automatic antiaircraft gun. This Weapon is replacing the ZPU-4

This is the fourth of a seven-article series concerning tactical instruments: See the October 1975 *DIGEST*, page 17; December, page 22; and January 1976, page 11. Next month watch for "Air Traffic Management And Tac Instruments"

"ABOVE THE BEST" BUT BELOW THE THREAT

Captain Lewis D. Ray

Project Officer
Deputy for Combat Developments
U.S. Army Aviation Center

Aviation operations against an enemy equipped with sophisticated air defense and electronic weapons will be significantly affected by the following factors. The commander may be faced with any of the following, singly or in combination, and must consider these factors in planning and execution of air operations.

- Air-to-air weapons
- Surface-to-surface weapons
- Surface-to-air missiles
- Air-to-ground missiles
- Jamming of aircraft traffic management systems
- Jamming of command and control frequencies
- Monitoring of communications among aircraft traffic by the enemy
- Monitoring command control radio nets by the enemy
- Helicopter attacks on helicopters
- High performance aircraft attacks on helicopters

THE HIGH THREAT environment poses special problems for the commander as he employs his aviation assets. The nature of this threat forces his aircraft to employ terrain flying techniques in order to survive, and precludes controlled flight in accordance with the AR 95-series regulations.

Not only must the commander cope with air defense weapons but he also must degrade the enemy's capability to jam, monitor and acquire as targets his electronic navigational aids, communication devices and radar signals. The latter threat makes minimum electronic communications, preferably radio silence, a requisite for aviation operations, and dictates the basic doctrine of orienting ground-

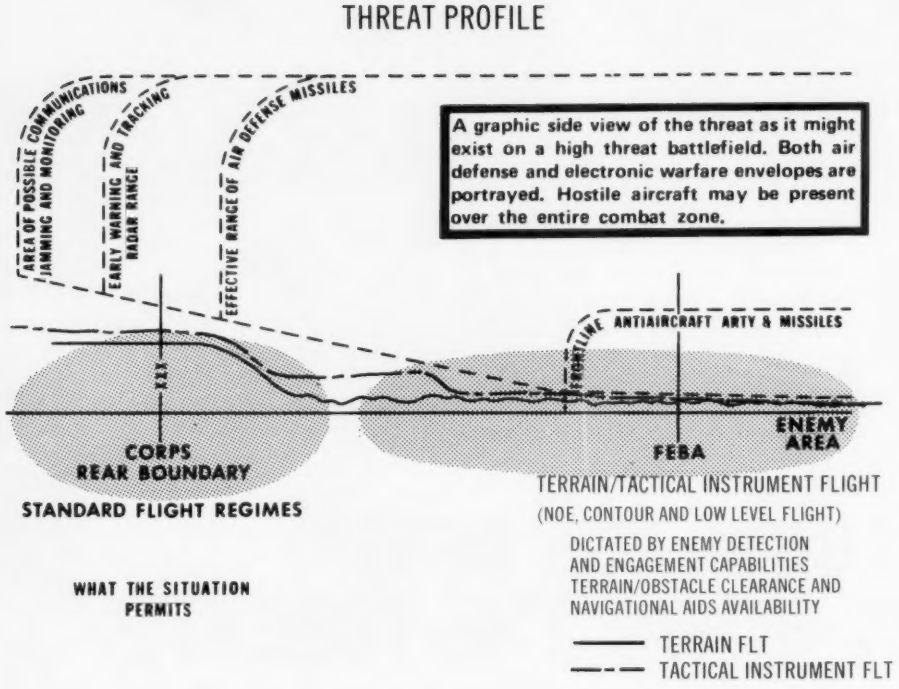

THREAT PROFILE
AREA OF POSSIBLE COMMUNICATIONS JAMMING AND MONITORING
EARLY WARNING AND TRACKING RADAR RANGE
EFFECTIVE RANGE OF AIR DEFENSE MISSILES
A graphic side view of the threat as it might exist on a high threat battlefield. Both air defense and electronic warfare envelopes are portrayed. Hostile aircraft may be present over the entire combat zone.
FRONTLINE
ANTIAIRCRAFT ARTY & MISSILES
CORPS REAR BOUNDARY
FEBA
ENEMY AREA
STANDARD FLIGHT REGIMES
WHAT THE SITUATION PERMITS
TERRAIN/TACTICAL INSTRUMENT FLIGHT
(NOE, CONTOUR AND LOW LEVEL FLIGHT)
DICTATED BY ENEMY DETECTION AND ENGAGEMENT CAPABILITIES TERRAIN/OBSTACLE CLEARANCE AND NAVIGATIONAL AIDS AVAILABILITY
TERRAIN FLT
TACTICAL INSTRUMENT FLT

Figure 1

based signal-emitting devices (such as radios and navigational aids) to the rear when feasible, moving them frequently and using them only when necessary.

Enemy threat considerations dictate the altitude levels at which Army aircraft will operate. In the forward areas, enemy surveillance radar and air defense weapon capabilities will require Army aircraft to use terrain flying techniques. Aviators must take advantage of concealment afforded by terrain, vegetation and man-made features.

In rear areas, aircraft operations may be conducted at higher flight levels depending on the threat. However, both in forward and rear areas, aviators always must take advantage of available terrain masking for cover and concealment to prevent observation or detection of the aircraft and its point of departure and landing. Figure 1 shows an example of how the air defense threat will appear on the modern battlefield. It graphically illustrates the relationship of tactical flight in rear areas to tactical flight in forward areas.

As the aviator flies toward the forward edge of the battle area (FEBA), he must lower the flight altitude in order to remain below the air defense threat. He may be able to use standard instrument flight rules and procedures, if necessary, in rear areas where the effective range of enemy air defense missiles and other weapons do not threaten. Of course, the aviator must be alert constantly to the threat of possible communications jamming and monitoring throughout the battle area.

Nearer the FEBA, he will encounter the range of the enemy early warning and tracking radar. It is important for the aviator to know when he is in this radar range even though he is still outside the effective range of the enemy air defense missiles and other weapons. Although he may be beyond the range of ground-based weapons, he may be engaged by enemy aircraft.

The aviator still may be able to fly at higher altitudes or use standard instrument flight procedures in this area, but should be transitioning to the lower flight altitudes of terrain flight or tactical instrument flight.

As the aviator continues to move forward toward the FEBA, he comes within the effective range of the air defense weapons. At this point, he must always remain low enough to avoid acquisition by the

early warning and tracking radar. In doing so, he must reduce the flight altitude to a level below the enemy threat, yet high enough to provide a safe clearance of terrain obstacles.

Naturally, as the aviator flies toward the FEBA, the capability of enemy radar to acquire him will continue to increase nearer the terrain. The aviator must continue to adjust his altitude and flight route accordingly to remain below this threat or to be masked by the terrain. Upon reaching the forward area or the destination point, the aviator will use a tactical instrument beacon to make the approach if visual flight rule (VFR) conditions are not encountered. If VFR conditions are encountered at the destination, then the aviator will make the approach visually and use terrain flying to continue the mission and avoid the enemy threat.

Conversely, as the aviator flies from a forward location toward the rear of the battlefield, he can progressively increase the flight altitude to provide an added terrain obstacle clearance safety margin, yet remain below the air defense threat.

Echelon or unit forward or rear boundaries cannot be used as a reliable indication of the altitude to be flown to avoid the enemy air defense threat. These boundaries are highly mobile and not always the same distance from the FEBA or subject to the same terrain formations.

The unit boundaries depicted in figure 1 are presented only to show how, as the aviator flies nearer the FEBA, the threat will increase and force him to select lower flight altitudes. Each mission must be individually planned and an appropriate altitude profile planned to remain clear of both the threat and terrain obstacles.

To illustrate this concept, a flight from the corps rear to a forward unit in the brigade area is described. The altitudes in these descriptions are used purely for sake of illustration. Current threat information should be consulted before any actual safe altitudes are established.

Figure 2 represents the progression of a helicopter flight from the corps support command (COSCOM) to a field location of a forward brigade.

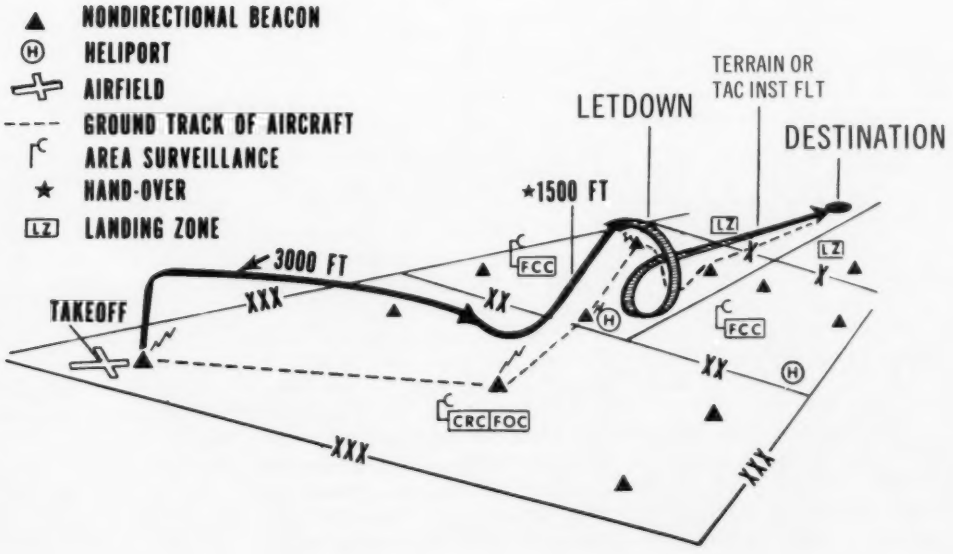
After a flight plan is filed and an air traffic control IFR (instrument flight rules) clearance is received, the helicopter takes off and communications are initiated with the flight operations center (FOC)/Air Force control and reporting center (CRC). Aircraft location and identification are confirmed by either radar or voice communication.

The helicopter proceeds via the clearance route using nondirec-

Figure 2

FLIGHT PROFILE FROM CORPS REAR TO FWD UNIT IN BRIGADE

ALTITUDES ARE BASED ON THREAT CONSIDERATIONS AND TERRAIN CLEARANCE



FLIGHT PROFILE FROM FEBA TO CORPS REAR AREA

ALTITUDES ARE BASED ON THREAT CONSIDERATIONS
AND TERRAIN CLEARANCE

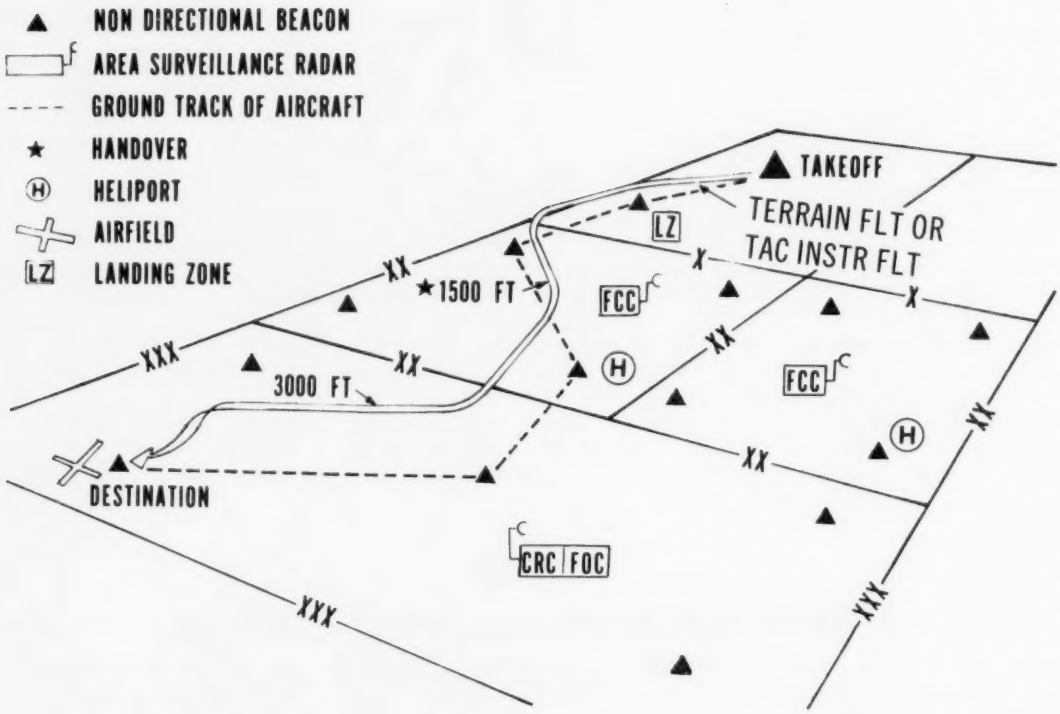


Figure 3

tional beacons if IFR or visually if VFR. Although an IFR flight clearance altitude will be provided to the pilot in mean sea level (MSL), obstacle clearance altitude above ground level (AGL) is a primary concern to the aviator. By preplanning flight routes early, the interpolation of MSL flight information to AGL use is easily accomplished.

As the helicopter approaches the division rear boundary, an air control line (ACL) or a predetermined transition point may be established at which the helicopter can be transitioned down to a lower altitude and handed over to the division flight coordination center (FCC) for further routing to the approach control facility serving the division main heliport or other intended destination.

The division controller can assist the helicopter to execute a tactical instrument approach, if necessary, at his destination. Or, if weather and terrain conditions permit, he may provide a ground controlled approach monitored descent to VFR which would allow the helicopter to proceed visually to the forward brigade location while using terrain flying techniques.

The radar-monitored descent may be flown away from the FEBA as a deceptive measure so as not to indicate the flight's destination point to the enemy. Additionally, this procedure will eliminate unnecessary telltale approaches to the division main heliport and will lessen the enemy's ability to fix it or to determine the helicopter's true destination.

Since forward area units normally will displace and relocate navigation and letdown facilities

frequently, aviators not intimately familiar with the local situation will often find it necessary to land at a facility in the division rear area. There they obtain information on the tactical situation, the threat, flight routes and tactical instrument flight procedures into the forward brigade area.

Now, let's consider an observation helicopter returning to the COSCOM from a divisional air cavalry troop conducting a screening mission at the FEBA (figure 3). Instrument meteorological conditions prevail.

The pilot may file a composite special VFR/IFR flight plan by landline communications prior to departure, or conditions may require him to file an instrument flight clearance while airborne. If communications with an FCC or flight clearance facility cannot be established prior to takeoff, the aviator must clear his own flight and attempt to establish contact with an FCC element after takeoff.

A related story, "The New Dead-Man's Curve," will appear in next month's *DIGEST*

As the aircraft proceeds to the rear and contact with the FCC element is established, the division FCC may recommend a higher flight altitude as threat conditions permit, thus increasing the safety margin for obstacle clearance. At an appropriate transition point, the division FCC will hand the observation helicopter over to the corps FOC/CRC which will monitor its progress by radar and continue to provide services for the flight to its final destination. It will then be handed over to the appropriate approach control for approach clearance.

Army aviators and commanders should be aware of the enemy air defense threat and how to avoid it in order to increase staying power on the battlefield and enhance aircrew survivability. If the aviator knows the enemy threat, and can avoid it and complete the mission *in both visual and instrument conditions*, he can truly remain "Above The Best" but below the threat.

Major George Coutoumanos (left) receives a check for $350 for his suggestion on the construction of a "Griffin Rig" from Colonel W.A. Samouce, division artillery commander

The Griffin Rig

Major George Coutoumanos, assistant fire support coordinator at 101st Airborne Division Artillery Headquarters, Ft. Campbell, KY, received $350 for his suggestion for the construction and utilization of a "Griffin Rig."

The "Griffin Rig" is a portable device that can be used to assemble and disassemble UH-1, AH-1 and OH-58 aircraft.

The "Griffin Rig" weighs less than 200 pounds, can be carried in the back of a 1-1/4 ton gamma goat, can lift 2,000 pounds and costs less than $105 in material to build. It allows for the rapid reassembly of aircraft in remote assembly areas where other support is not available. The "Rig" can remove and replace rotor and hub assemblies, masts, transmissions and engines off aircraft; and can be assembled by a crew of four in less than 5 minutes. It gives units down to company level the capabilities of performing maintenance in field locations and has been adopted for utilization throughout XVIII Airborne Corps aviation units.

The idea came to MAJ Coutoumanos as a result of an off-post exercise where there was a need for a portable device to aid in the assembly and repair of aircraft in remote field locations.

A Griffin is a mythological beast, half eagle and half lion, known for its fierceness.

U.S. Army

Foreign Science and

Mr. Da

Intelligence Res
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Charlotte

" . . . keeping abreast of the competition is not enough . . . "

Colonel Robert A. J. Dyer
Commander/Director
FSTC

d Technology Center

r. David Latt
e Research Specialist
Science and Technology Center
rlottesville, VA

KEEPING TRACK OF foreign scientific and technological developments relating to ground force military hardware is the task of the U. S. Army Foreign Science and Technology Center (FSTC). Located in Charlottesville, VA, about a 2-hour and 20-minute drive from the Pentagon, Washington, DC, the Center is assigned to the U. S. Army Materiel Command (AMC).

With an authorized strength of 465 (30 military and 435 civilians), FSTC processes, analyzes, interprets, evaluates and integrates information concerning:

- Foreign developments in basic and applied research in the natural and applied sciences.
- Applied engineering techniques.
- Technical characteristics, capabilities and limitations of all foreign military systems (other than ballistic and antiballistic missile systems and medical materiel), weapons, weapon systems and materiel, as well as research and development (R&D) related thereto, and the production methods employed.

About 135 production analysts—professionally skilled in the physical, life and engineering sciences—author national level finished intelligence studies, reports and briefings as authorized by the Defense Intelligence Agency (DIA); the Office of the Assistant Chief of Staff for Intelligence (OACSI); and AMC. An additional 241 specialists are engaged in intelligence production information services or collection requirement activities directly supporting the intelligence requirements of AMC and other consumers of national level intelligence such as Central Intelligence Agency (CIA); National Security Agency (NSA); the Energy Research and Development Agency; and the elements of the Department of Defense.

FSTC was established 1 August 1962 as a Class II activity under the command jurisdiction of AMC. Its formation was the result of a reorganization of the Army's technical intelligence resources brought about by the increasing emphasis placed on technological R&D since World War II, and the creation of AMC.

Prior to 1962, the individual technical services, i.e., Signal, Ordnance, Quartermaster, Engineer, Chemical, etc., operated independently, using their own intelligence offices and facilities to meet their special requirements. As a prelude to eventual centralization of the Army's technical intelligence resources, most of the technical services intelligence officers were located at Arlington Hall Station, a few minutes away from the Pentagon. This action was taken during the latter part of the 1950s and proved to be most beneficial when the actual merger took place a few years later.

During the planning stages of the general reorganization within the Army, the question arose as to where to put the Army's technical intelligence

resources—with the Office of the Assistant Chief of Staff for Intelligence; the newly organized Defense Intelligence Agency; or the proposed Army Materiel Command. Based on the need for intelligence on foreign R&D activities to prevent technological surprise, it was decided to place the Army technical intelligence resources with the Army Materiel Command. The Air Force Systems Command and its subordinate Foreign Technology Division was a model followed by the new Army Materiel Command and its technical intelligence resources. Also used as a model was the Army's recently reorganized missile development activities.

To carry out its mission, the FSTC organization provides for an **Intelligence Production Directorate** and an **Intelligence Support Directorate.** The **Intelligence Production Directorate** directs, controls and coordinates the scientific and technical production programs as functionally assigned to six subordinate divisions. These divisions provide all-source, worldwide scientific and technical intelligence as follows:

- *Sciences Division:* Covers foreign basic and applied sciences; including all R&D organizations, facilities, personalities and programs which affect, or have potential effect on, materiels and equipment, both present and projected, in relation to the development of military technologies and ground force interest.
- *Chemical, Biological and Explosives Division:* Keeps track of foreign munitions technologies—included are ground force nuclear, radiological, biological, chemical and mine warfare developments—and the chemistry and physics of explosives and propellants. Provides explosive ordnance disposal (EOD) agencies in the Army, Navy and Air Force with all required and available technical information on foreign explosive ordnance materiel.
- *Military Capabilities Division:* Satisfies U. S. Army intelligence needs for foreign ground forces command, control and communications systems; threat assessments and analyses; and the logistics, materiel readiness, and environmental influences on foreign materiel requirements, design and employment. Directs the current intelligence program for the FSTC. Provides intelligence support to the U. S. Army Systems Review Programs.
- *Communications and Electronics Division:* Follows foreign ground forces communications and electronics developments, equipments, deployments and capabilities that may be a threat to the U. S. Army. Performs systematic appraisals of foreign communications and electronics to ascertain significant advances, trends, direction and patterns that may influence U. S. R&D programs.
- *Weapon Systems Division:* Satisfies U. S. Army intelligence needs for foreign ground force combat systems and their components, including materiel performance and operational capabilities, characteristics, related applied research and technological developments, and methodology associated with development, testing, manufacture, troop training, utilization, maintenance and effectiveness. Forecasts future developments of foreign combat systems.
- *General Equipment and Transport Division:* Satisfies U. S. Army intelligence needs for foreign research and development programs; and on characteristics and capabilities of present and projected items of general military equipment and transportation equipment and their components and subsystems, including related applied research and technological developments, related facilities and personalities.

FSTC armor specialists (left to right) Mr. David B. Hardin, MAJ John B. Halley and Mr. Clyde C. Micham study a model of a Soviet combat vehicle

The **Intelligence Support Directorate** directs, controls and coordinates the functions supporting the FSTC intelligence production program as functionally assigned to its five divisions. The directorate exercises staff supervision and operational control over the Scientific and Technical Information Team—Europe, and the Science and Technology Center—Far East Office. The divisions in the directorate are:

- *Foreign Activities Division:* Provides all-source, foreign scientific and technical information on materiel collection support to AMC, OACSI and DIA as required. Manages the program for

exploitation of foreign materiel which encompasses the receipt, exploitation, utilization and disposition of foreign materiel obtained for intelligence and/or research and development purposes.

- *Information Services Division:* Operates a multidisciplinary all-source, foreign scientific and technical information element responsive to the intelligence requirements of FSTC, AMC and the Department of the Army (DA). It also exploits foreign language literature.
- *Production Support Division:* Provides intelligence production support in the areas of technical publication editing, technical composition, lithographic services, audiovisual (including motion picture) and graphic arts.
- *Computer Systems Division:* Plans, develops and manages FSTC Intelligence Data Handling Systems; conducts applied operations research; and provides computer-based automatic data processing system design and operational support to FSTC.
- *Field Support Division:* Provides foreign intelligence support to FSTC, AMC commands and separate activities as directed; receives, stores, maintains, controls and disposes of foreign intelligence materiel; fabricates scale models of foreign materiel; designs and constructs displays and exhibits of foreign materiel. This division is physically located at Aberdeen Proving Ground, MD.

FSTC provides direct support to AMC and DA with a wide variety of scientific and technical products designed to fill both immediate and short range requirements of the Army consumers and the R&D community. Most frequently produced are letter and message reports responding to specific requirements of limited scope. FSTC also presents about 300 briefings annually covering the entire spectrum of foreign scientific and technical development. These briefings, one of the most suitable media for the dissemination of current and perishable intelligence, are presented to audiences at all levels ranging from R&D technical personnel to the highest command and staff elements.

In addition, the following products respond to validated tasking levied by the DIA:

- DIA Scientific and Technical Intelligence Studies: These are published as DIA or DIA-approved documents and are bound in a blue cover.
- DA, AMC and FSTC Scientific and Technical Intelligence Studies: These are produced as DA studies that do not necessarily have the approval of DIA. Products are bound in a yellow cover.
- Current Intelligence Products:
  - √ Army Scientific and Technical Intelligence Bulletin (ASTIB): A DA-approved monthly publication intended for general consumer use, for internal departmental use and for exchange of intelligence findings among intelligence producers. Products are bound in a salmon cover.
  - √ Weekly Wire (WW): An all-source "spot" report, with FSTC analytical comment. It is prepared for distribution to general officers, certain key civilians and other producers of intelligence.
  - √ Biweekly Scientific and Technical Intelligence Summary (BSTIS): Provides scientific and technical intelligence to personnel at all levels of AMC's intelligence and R&D community.
  - Foreign Materiel Exploitation Reports.
  - Foreign Materiel Catalog (FOMCAT): A 24-volume product covering a wide range of ground force weapons and equipment.
  - Translations.
  - Materiel Models.

FSTC is under the leadership of COL Robert A. J. Dyer, a Master Army Aviator. He is a veteran of more than 25 years of military service, including stints in China with the Flying Tigers, in Korea with the 7th Infantry Division and in the Republic of Vietnam.

In the words of COL Dyer, FSTC is, "responsible for preventing a technological surprise to the United States in the area of ground forces." In addition to attempting to ensure that the Army stays equal to and preferably ahead of other nations in equipment and weapons, FSTC also does its best to help prevent the Army from wasting time and resources trying to engineer or develop something that already has been developed or engineered abroad.

Success has marked FSTC's efforts. For example, analysis of reports of a development by the USSR of a special pontoon bridge (which unfolded automatically in the water and permitted rapid bridging of a river) led to the construction of models and eventual "reverse engineering." The United States soon knew how to build a similar bridge with a few improvements. The action saved literally millions of dollars in development costs for the U. S. Ribbon Bridge.

COL Dyer reminds visitors to FSTC that, "keeping abreast of foreign scientific and technological developments is a dynamic operation. In this age of technology, changes occur very quickly. What is advanced technology today may be outdated tomorrow. Our supporting role to the U. S. research and development effort requires constant analysis of foreign military research and development programs. But—keeping abreast of the competition is not enough—we must maintain a substantial lead."

FATIGUE

USAAAVS

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It's a cause of overconfidence, poor judgment, mistakes—even fatal accidents. Yet, few people recognize or appreciate the effects of fatigue on aircrew performance

FATIGUE IS a significant hazard in Army aviation. It reduces crewmember efficiency and contributes to reduced performance, poor coordination, faulty memory, slower reaction time and a decline in perceptual abilities. Fatigue can lead to overconfidence, poor judgment, mistakes—even fatal accidents. In spite of this, few people actually appreciate the full extent and consequences of the effects of fatigue on aircrew performance. Often, aircrew fatigue receives little, if any, consideration by investigation boards as a cause or contributing cause factor in accidents. Also, many units fail to establish maximum flight time and crew rest limitations in accordance with paragraphs 5-8 through 5-10, section II, AR 95-1.

• A fixed-wing pilot was on an administrative mission which required dropping off a passenger at point A, picking up a passenger at point B and returning to homebase. He filed a VFR flight plan for the first leg of the mission. After arriving at point A, he then filed an IFR flight plan to proceed to point B. En route to this point, he contacted the air traffic control center and requested and received radar guidance vector around and between large thunderstorm cells along his flight route. After two heading changes and reported moderate turbulence, he was given and acknowledged another change in heading. Radar operators tracked the aircraft through a clear area between two large thunderstorm clouds just before the aircraft disappeared from the display. Witnesses who saw the aircraft below the clouds just before impact reported that it was in a shallow dive, then suddenly started a violent, rapid roll to the right, and began a near vertical descent before disappearing behind the trees. The pilot was killed and the aircraft destroyed.

This accident was caused by the pilot flying into known severe weather conditions. He filed an IFR flight plan and flew without a copilot into forecast instrument conditions in violation of paragraph 4-21, section IV, AR 95-1.

This man was a senior Army aviator with 3,645 flying hours. He was also an instructor pilot in the type of aircraft involved in this accident, and was thoroughly familiar with the aircraft and its equipment. He was an experienced weather pilot with 275 hours of weather instrument flying time and was a fixed-wing instrument flight examiner.

Why would an experienced pilot use such poor judgment? And why did he violate regulations? Many reasons can be attributed to lack of or inadequate supervision and disregard for the aviator's physical and mental well-being.

Provisions of AR 95-1 pertaining to flight time limits and crew rest were not implemented in local directives or SOPs. Prolonged periods of flying which exceeded the limits of safe physical and mental endurance were scheduled. If at all possible, flights were completed in one day so the aircraft and pilot could be available for scheduling the following day. Crew rest at destination following a long flight was secondary to returning the aircraft to homebase. Pilots in the unit were averaging 100 hours per month or more just for administrative or cargo missions and this particular pilot had averaged 112 hours flying time per month during a 7-month period. He had just completed a flight of 17.2 hours and, after only 4 hours of rest, departed on the fatal flight. It is believed that fatigue caused by a combination of inadequate rest and extensive duties as pilot in command during the 17.2-hour mission undoubtedly affected this pilot's judgment.

The provisions of AR 95-1 covering the use of copilots on all flights into forecast instrument conditions were not enforced. It was the policy of the unit to bring this requirement of the AR to the pilot's attention. However, pilots were not required to adhere to the regulation nor were they disciplined when it was violated. There was not a copilot present during the fatal flight or on the preceding flight. Had a copilot been present, his added observation and experience may well have helped detect the severe weather in time to prevent the crash.

A situation of apprehension and anxiety existed among the aviators assigned to the unit, as some believed that failure to fly all scheduled missions regard-

less of rest, forecast weather conditions or copilot availability would be detrimental to their Army careers.

Internal supervision of the unit was the exception rather than the rule. As the unit was operationally oriented and short on aviators, the commander was away on missions most of the time and the chain of command was not used in the operation of the unit. Pilots were oriented and then largely left on their own.

• During a simulated antitorque failure with the pilot on the controls, the AH-1G touched down in a nose-left attitude, bounced and became airborne again. The IP took the controls and attempted to level the aircraft, but it struck the ground again and rolled to the left, allowing the main rotor to strike the ground. The aircraft then rolled onto its right side.

Both crew and supervisory error caused this accident. The IP allowed the aircraft to touch down in a nose-left configuration due to error in altitude judgment caused by a greater than normal sink rate and pitchup condition. In addition, he allowed the pilot to reduce throttle before proper aircraft alignment with the sod runway.

The maneuvers were being performed in a soft sod touchdown area in accordance with the unit's standardization policy. However, these maneuvers should have been performed in either hardstand or hard sod areas because of the critical center of gravity of the AH-1G.

Crew judgment may have been impaired due to abnormal duty hours. The unit SOP did not provide for crew rest following extended flight periods or night flights. The flight surgeon stated that the IP and pilot had flown until 2400 hours the night before and had not gotten to bed before 0100 the morning of the accident. Both men were awake by 0730 the morning of the accident.

The flight surgeon recommended the following be added to the unit SOP. "Aviators extending their duty day beyond 2200 hours while involved in peacetime, nontactical missions shall be released from duty for 10 consecutive hours. This provides adequate travel time to and from duty station and allows for 8 hours of sleep and/or rest."

• Following a two-phase night training operation, an OH-58A pilot and copilot with two passengers aboard were returning to home base. After completing an approach in a tactical "H" sod landing area, the pilot received clearance to proceed to the parking area. During a hovering left turn from a brightly lit to a relatively dark area, the right skid and rotor blades struck the ground and the aircraft rolled onto its right side. This accident was caused by the pilot operating the OH-58A at too low an altitude to allow sufficient time for corrective action. Fatigue was a suspected factor because the pilot had been awake for 16.8 hours and had just completed a series of landings at a tactical landing field in a location with few ground reference lights.

These accidents show the detrimental effects of fatigue both on individuals and mission accomplishment. So what can we do about fatigue? Well, first of all fatigue is not a subject that lends itself to easy solutions or pat formulas. In fact, there are so many variables that no one has really arrived at a completely scientific definition of fatigue. Perhaps it can best be defined as those changes which affect an individual's physical or mental state due to stress from continued activity. Typically, these changes are a deterioration in an individual's performance or an increased effort to maintain a given level of performance, and subjective feelings which may include irritability, tension, mental sluggishness, tiredness and lack of energy.

Even more disturbing is the fact that fatigue cannot be realistically measured because no two individuals are alike, as they vary in eating and sleeping habits, emotional makeup, resistance to fatigue, etc. In fact, even the capability to resist the effects of fatigue varies within the same person at different times. While biochemical measurements have shown organic changes in breathing, blood pressure, heart rate and fatigue products in the blood in an individual after physical exertion, this method is impractical for use in a field environment. And, to date, a way has not been devised to measure mental fatigue. So, consequently, we must learn to recognize stresses created by the demanding tasks of the aviation environment on the aviator's efficiency.

There are actually two levels of fatigue—acute and chronic. Acute fatigue is the more common and is caused primarily by excessive mental or physical activity. It is temporary and is ordinarily relieved by a period of sleep or rest and relaxation. However, when acute fatigue is not relieved, but prolonged from day to day, it can lead to chronic fatigue which is more serious and incapacitating. Unfortunately, this type fatigue is not generally relieved by periods of sleep and rest, but usually requires an extended period of time for recuperation. But it can be eliminated if acute fatigue is dealt with on a daily basis. There is actually no clear dividing line between these

TABLE 1.–Signs and Symptoms of Fatigue (Mental, Physical, and Physiological)

- Physical exhaustion.
- Increased effort to carry out work.
- Increased rate of errors, especially at end of mission.
- Tenseness of body muscles; stiff neck; tremor.
- Tendency to doze; need of sleep.
- A feeling of "not being sharp."
- Unusual difficulty in following instructions; things seem hazy.
- Need to recheck actions; uncertain about decisions.
- Diminished range of attention; deterioration in judgment.
- Acceptance of greater tolerances in instruments and controls.
- Acceptance of unnecessary risks.
- Vague headaches.
- Increased startle response.
- More frequent sighing.
- Irritability, fault-finding, impatience, temper flareups.
- Unusual preoccupation; forgetfulness.
- Sense of discomfort and failure.
- Boredom; loss of motivation; lack of group interest.
- Tendency to carelessness.
- Inability to concentrate.
- Increased reliance on coffee, tobacco, and alcohol.
- Loss of appetite and weight.
- Social withdrawal; resentment toward others.
- Nonconformity; asocial acts.
- Decreased personal cleanliness.
- Insomnia, nightmares, radical change in sleep habits.
- Confusion, chronic anxiety; fearfulness; depression.
- Vague chest pains, difficulty in breathing.
- Vague visual and/or auditory disturbances.
- Failure to integrate instruments as a unit.
- Unaware of errors and error accumulation.
- Splitting of complicated tasks into component parts.

two levels of fatigue, as the signs and symptoms are the same. The only difference is in the variation of intensity and duration. To aid supervisory personnel and individuals in recognizing the presence of physical, mental and physiological fatigue, some of the signs and symptoms to look for are listed in table 1.

Crewmembers have to cope with numerous fatigue-producing stresses, such as those imposed by aircraft factors, flight operation factors, duration of work and rest in the duty day, scheduling of work and rest cycles, social, emotional and self-imposed factors and morale. These stresses may either operate alone or in combination to reduce an individual's physical, physiological and mental well-being. Actually a little stress is not a bad thing. Slight tension produced by stress, as evidenced by mild anxiety, generally causes a person to be more alert and cautious and moderate stress can often improve performance. But it's the excessive stress that's disruptive and causes problems.

To determine which factors in the aviation environment have the most bearing on fatigue, a survey of 500 experienced helicopter pilots was conducted by the Advisory Group for Aerospace Research and Development (AGARD). The results of this survey are shown in table 2. At the time of the survey, day or night nap-of-the-earth (NOE) flying was not included in the list of factors for selection. However, NOE and particularly night NOE would almost have to be placed near the top of the list, as stress factors caused by night NOE create more fatigue on the aviator than any other type of flying.

Now that we've seen some of the signs and symptoms of fatigue and those factors which appear to be the most deleterious to crewmembers, the next problem is how can it be prevented? Unfortunately, prevention of all fatigue, especially acute fatigue, is impossible as there can be no productive work without some degree of fatigue-producing stress. However, it can be minimized with crew and environmental controls and the more serious chronic fatigue can be avoided if acute fatigue is dealt with on a regular basis. To minimize the likelihood of the development of chronic fatigue, following are some measures which should be taken.

Ensure adequate training. With good leadership, the men of a unit will be prepared, disciplined and trained to undertake a given mission. This will maximize their performance in the face of known stress and inevitable fatigue. Without training, discipline, leadership and a sense of esprit de corps, a unit and its members are ill-prepared to confront

TABLE 2.–Items Contributing to Fatigue Ranked in Order From Most Important Through to Least Important

Item	Rank Order
Instrument Flying	1
Exposure to Hostile Action	2
Limited Visibility	3
Sleep	4
Duration of Flying Duty Day	5
Monotony of Mission	6
Seating Comfort	7
Additional Duties Unrelated to Flying	8
Daily Rest	9
Aircraft Vibration	10
Low Level Flying	11
Night Flying	12
Aircraft Noise	13
Hunger and Thirst	13
Command Relationships	15
Adequacy of Ground Support	16
Morale	17
Dawn or Dusk Flying	18
Type of Terrain	19
Glare	20
Attitude Towards Mission	21
Interest in Mission	22
Avionics (Radios)	23
Navigation Instruments	24
Hovering	25
Emotional Outlet	26
Family Security	27
Aircraft Instruments	28
Cabin Lighting at Night	29
Relationships with other Military Personnel	29
Reliability of your Crew	31
Helicopter Limitations	31
Effort Required for Helicopter Control	31
Recreational Facilities	34
Aircraft Heating	35
Landing	36
Financial Security	37
Aircraft Reliability	38
Field of View from Cockpit	39
Takeoff	40
Social Relationships	40
Control Feel	42
Rotor Blade Movement	43
Flying Clothing	44
Intercom System	45
Fumes	46
Seat Belts	47

even the simplest stresses of the aviation environment.

Encourage good physical conditioning through beneficial forms of recreation. Controlled physical conditioning prepares one for the enduring tasks at hand and improves mental outlook. It also increases

TABLE 3.–Comparison of Actual Flying Hours/Rest Periods in the Various Aviating Agencies for Rotary Wing Aircraft

Nation	Agency	Duty/Flying Time	Rest Period	Working Group's Comments
All NATO Nations	STANAG 3527 MED	Single pilot 90 hrs/month Multi pilot 125 hrs/month	As recommended by flight surgeons	Not specific enough
Belgium	Army/Air Force	As STANAG		Not specific enough
Canada	Navy	10 hrs in any 24	9 hrs in 24	Rule exists that there is a minimum time between flights from 8 to 4 hrs
	Army/Air Force	18 hrs on duty maximum	12 hrs between duty	
Denmark	Air Force/Navy/ Army	As STANAG		Not specific enough
France	Air Force/Navy	Similar to STANAG		
	Army	60 hrs flying in a month 3-5 missions maximum in any 24 hr period	Not specified	Not specific enough
Germany	Air Force/Navy/ Army REG ZDV 19/2	6 hrs solo–8 hrs dual in any 24 hr period and 40 hrs in any 28 days	Should be at least 12 hrs	Rest periods should be specified
Italy	Air Force/Army	Similar to STANAG	Flight surgeons/ comm. discretion	Not specific enough
Greece	Air Force/Army	Similar to STANAG	Flight surgeons/ comm. discretion	Not specific enough
Netherlands	Air Force/Navy/ Army	5 hrs flying per day per crew	Should be at least 12 hrs	Rest period should be specified
Norway	Air Force/Navy/ Army	7 hrs flying in 24 hr period 12 hrs flying in 48 hr period 90 hrs flying in 30 day period	Not specified	Rest period should be specified
Portugal	Air Force	Similar to STANAG	Not specified	Rest period should be specified
Turkey	Air Force	Similar to STANAG	Not specified	Rest period should be specified
UK	Army	Day–8 hrs flying in any 24 Night–4 hrs flying in any 24	Day–not specified Night–8 hrs rest	Rest period should be specified
	Navy	Day–8 hrs flying in any 24 6 hrs in prolonged ops Night–6 hrs flying in any 24	Not specified	Rest period should be specified
	Air Force	Max. crew duty time 14 hrs Day–7 hrs flying in any 24 Night–3 hrs flying maximum	12 hrs off	
US	Army	140 hrs flying in 30 days	Should be 12 hrs but only a guide	Rest period should be specified
	Air Force/Navy	AFM-60-1 Navy similar max. crew duty time 14 hrs	12 hrs off	
Australia	Army/Air Force	20 hrs flying in 6 days maximum of 12 hrs duty in 24. Maximum 14 hrs in operational emergency	1 day off in 7 10-12 hrs rest in 24 hrs	

the likelihood that sleep will be natural and protective.

Minimize the self-imposed stresses. While largely an individual task, great strides can be made by a commander by setting the example and discouraging conditions which would enable the easy development of bad habits, such as heavy smoking, alcohol overindulgence, overexertion, moonlighting, etc.

Recognize accomplishments through awards and decorations. Recognition of one's accomplishments increases motivation. Even though crewmembers may be mentally or physically tired, well-motivated individuals are emotionally instilled with a spirit of success which results in mission accomplishment.

Monitor crewmembers. Because of the multiple complex stresses involved in aviation and the fact that it's human nature for an individual not to realize when he's too tired to fly efficiently and safely, commanders, flight surgeons and aviation safety officers must monitor individuals for signs of fatigue. Not only does fatigue need to be monitored in crewmembers, but also in maintenance ground personnel, ground guides or any individual associated with the safe operation of Army aircraft, as one mistake on the part of any of these individuals can result in an accident. To accomplish this, supervisory personnel must have an intimate knowledge of their men. This can only be achieved by frequent participation in their duties and missions and by close surveillance of their responses to stress. Commanders must recognize the safe limits of human performance and the uniqueness of an individual's capacity. Commanders who consistently require their flight crews to exceed their limitations and who fail to allow for adequate crew rest can expect mistakes and accidents. In addition, flight surgeons and aviation safety officers must be alert for the subtle reflections of compromised performance in crewmembers. Aviation safety officers should ensure that crewmembers are educated in effects of fatigue and how to control fatigue-producing stresses. And last, but not least, individuals must be aware of their capabilities and avoid overextending themselves at the expense of efficiency and safety.

Limit flying hours and establish crew rest periods. AR 95-1 allows for flight time and crew rest limitations to be established at the discretion of unit commanders based on type mission and aircraft, operating conditions, weather, time of flight, diet of crewmembers, physiological and psychological conditions of crewmembers and available rest facilities. While established work/rest cycles is an approach to controlling fatigue, it is not a panacea to the problem because of the many variables involved with each individual, mission, aircraft and environment. Also, the number of nonflying work hours accomplished by an individual must be taken into consideration.

The U. S. Army Agency for Aviation Safety (USAAAVS) is currently conducting an in-depth study of human factors, including fatigue, which have contributed to Army aircraft accidents. Preliminary results of this study revealed that during a 5-year period, fatigue was reported as a factor in 6 percent of rotary wing accidents (117 of 3,139) and 4 percent of fixed wing accidents (16 of 455). However, this does not represent a true picture of accidents in which fatigue was a factor because the standards established at various units for crew rest and flight duty also vary. Further analysis of fatigue is also hampered because flight activity information recorded on DA Form 2408-12 for all aviators is not available at USAAAVS and there is no way of knowing just how many "tired" pilots did not have accidents. Until this information is available, it is impossible to determine the validity of any standard based on hard data, and any standard agreed upon must, of necessity, be based on a subjective appraisal of each individual unit's mission to be flown. For example, an AH-1 aviator flying night NOE will become fatigued much faster than a U-21 aviator flying cross-country in "field-grade" weather.

Presently, short-range plans by USAAAVS are to develop subjective general guidelines based on a questionnaire answered by experienced Army aviation personnel. Long-range plans are to develop more definitive standards based on flight activity information as well as accident experience. As an interim measure, however, commanders, flight surgeons, aviation safety officers and individual aviators at unit level will have to develop flight time and crew rest standards based on their particular types of missions and aircraft as stated in AR 95-1, dated 18 October 1973. The standards of other services listed in table 3 for rotary-wing helicopters may be used as a starting point, but this must be followed by a daily evaluation of missions to be flown and the physical and emotional status of crewmembers.

WO1 Burton E. Crockett

USAAAVS

WITH TIME AND experience, individual attitudes change. Once the shine begins to wear off a new job, that which was once exciting and glamorous becomes routine. All too often the shine wears off the individual, too. The passing of time takes away the looking forward to each new day and the experience that it may bring. In its place comes complacency and a tendency to overrationalize our actions in our everyday jobs.

The attitude we were trained to develop while undergoing flight training was one of rigid compliance with a set of prescribed procedures. The thought of deviating from these rigid rules was enough to make even the most unconcerned student pilot blanch with fear at the thought of the consequences. The set of tolerances we were used to working with was one which demanded an extremely high level of performance at all times. It was an atmosphere of relaxed professionalism where we complied with all prescribed rules and regulations because we were told repeatedly, and believed, that there was a reason for them; not because it was a requirement placed on us by some regulation.

The experienced aviators who worked as instructor pilots in our flight program seemed to have an almost frightening amount of knowledge and were alternatingly respected immensely and hated fervently for it. The attitudes they projected and the performance they expected were based on knowledge gained through a vast accumulation of experience. Not all their own experience, because they realized that even though they had more experience, students could also come up with useful ideas and worthwhile suggestions. They realized that at times they were too close to the trees to see the forest. They not only listened when a student suggested, they encouraged the student to do so, and often with surprising results. These were the same professionals who maintained that the only stupid question was the one that wasn't asked.

As each day went by these men seemed to push harder and demand more and more until we thought our heads would burst if we had to learn one more procedure or one more limitation. But regardless of

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the pressure, we learned and eventually it became a habit and no longer seemed hard or unreasonable.

Then came the day all of us had waited for and dreamed about, the day of graduation. I am sure we remember a great many things about that day. We remember the pride we felt for ourselves and for our fellow aviators. We also probably remember our thoughts about those who had started with us and were now gone. When a member of our class was dropped we all felt badly about it. But on that last day perhaps our thoughts were a little more seasoned and we could look back with a better perspective and a small amount of additional wisdom.

There was a small (hopefully) percentage of us who were glad to be leaving "this school" and get away from all the "stupid regulations" so we could get to a real unit and do some flying like we had heard about.

Some of us probably remember that sad look in the eyes of those men who had spent so much of their time and energy teaching us the fundamentals of aviation. Could that look have been because they knew what awaited us in that "real unit" we had dreamed about?

Finally, we were in our first "real unit," working with "real aviators." They, for the most part, had combat experience and seemed to be everything we had thought they would be. They were, for the first few weeks. No man could have lived up to the ideal we had created, but we started to notice things being disregarded that even an average aviator should normally do.

It really started to dawn on us that there was something different going on when we overheard some of those salty old pros talking about all those ridiculous regulations. "They are fine for flight school," they said, "but it is sheer stupidity to expect me to comply with that." "I know my own limitations a lot better than some idiot who sits behind a desk and writes these things." This didn't really sound like the professional attitude we had been told would be our road to survival. But, we decided, they must have had a bad day and were just looking for something to blow off steam about.

The very next day when we got ready for a flight, just a regular VFR training flight, and we asked what the procedure was for getting a weather briefing, we were told, "You aren't still in flight school. Take a look out the window and check off the block on the flight plan. We haven't got time for all that. And get rid of all that junk in your helmet bag. The regulation that requires all that stuff is ridiculous and I won't fly with it in the cockpit. Besides, I know all the approach procedures around here and if we go IFR we will just get a PAR (precision approach radar) back into here. That radar hasn't been down since I got here."

We thought all of this was pretty out of the ordinary, and the warning system that had been built into our heads in flight school started to go off. But wasn't this the man we had heard so much about? Wasn't he the one who had flown all those combat missions and come back alive? We finally decided we should just follow his advice and not cross him. We didn't want to wind up like the IP in the unit who was shunned, it was rumored, because he slept with a dash 10 and a regulation and not his wife.

We walked out to the aircraft and began to open up our checklist for our preflight inspection. "What is that?" we were asked. "I don't need that thing. I have more time preflighting these things than you do in the Army. Why don't you just go strap yourself in and I'll look her over. I just flew her last night so I know there isn't anything wrong. Besides, if you start looking at things you might mess something up. What do they teach you people in flight school nowadays? When I went through we had to memorize that thing."

Feeling just above a complete idiot we tucked our tail between our legs and went up to strap into the front seat with a last warning of, "And don't touch anything. I don't want you to hurt yourself." Before we even had a chance to get strapped in, he was climbing into the rear seat and starting through his cockpit check. We remembered those gruelling hour-long preflight inspections in flight school and we wondered what exactly "they were teaching us in flight school nowadays." Being thoroughly convinced by now that we didn't know anything, we didn't even bother to offer to read the checklist but just settled back and tried to relax as we put on our helmets.

We began to enjoy the beauty of it all as we remembered why we had loved flying these machines so much as we broke ground and headed down to the south for some hood work.

"Put our names in the logbook and log me for pilot hood time," he said.

As we read the logbook we noticed that the "daily"

had not been signed off and there was a red X that our "back seat" had signed off.

But by this time we figured he knew what he was doing and we just sat back and relaxed. We asked him if he would like to use our hood and he said, "Boy, you've got to learn that all those regulations are fine for flight school, but we just don't have the time for all of that out here in a real unit."

As the flight progressed and he showed us a few new maneuvers that he said he had used in combat, we began to notice that the weather was getting worse. By this time we had all the confidence in the world in our "back seat" so we didn't worry. We felt that he could handle any situation that might come up. He was beginning to shine again as the old pro we had heard so much about.

When the time came for us to head back in, the weather had deteriorated to the point where we had to fly on top of the trees to stay VFR. This didn't bother us as we had all been through NOE training at flight school and were used to working in that environment. That seemed like a thousand years ago now. We felt that some of the salt from our "back seat" was beginning to rub off on us. We were really amazed at how much we could learn in just one day.

"Well boy, it looks like we are going to have to punch up through this stuff to get back home. We can just fly on top until we find a place to let back down."

"But isn't it better to just sit down and wait it out?" we asked.

"What? Me sit down for a little weather? I'd be the laughing stock of the whole unit. Besides, I've done this a hundred times so there's nothing to worry about."

We look down at our instruments and notice that we sure have a lot of torque pulled in. But he knows what he's doing. The aircraft starts to lose airspeed and climb faster and we think our "back seat" could be doing a little better on the gauges. We pass through 3,000, then 4,000, then 5,000, and we still haven't broken out. We start to have second thoughts about all of this as we remember the correct procedures from flight school. But we don't want to make him mad again so we don't say anything. He finally levels off at 6,000 feet and from the way the aircraft is acting we think that either we are in turbulence or he should have used that hood a little more often than he did.

"What's the frequency for our NDB?" he asks.

"We don't know," we answer. "And we don't have our publications so we can't look it up."

"What good are you as a copilot if you can't even remember to bring along your publications?"

We say we're sorry and we won't let it happen again. Then we start to wonder if he is going to contact someone and let them know where we are. We remember that as a procedure from flight school.

All thoughts of regulations and procedures leave our minds as the aircraft starts to go out of control. We ask if there is something wrong and he says he is getting vertigo and we are going to have to take the controls. We get the aircraft straight and level and ask if he is going to call home base for that PAR.

"Well, I guess so," he says. "But I sure hate to as it is going to be hard to explain how we got up here."

We say that is okay as long as we get down alive. But he says, "Let's go just a little longer and see if we don't break out of this." We don't have time to argue. The weather is getting worse and we are having problems just controlling the aircraft. Right now we would take advice from the devil just so we could have someone to tell us what to do.

Suddenly, everything starts to move in slow motion as we feel something slam into the aircraft and it yaws and the nose drops down. We try to look around to see what is causing that screaming noise in the earphones. Midair, we think. WE'VE HAD A MIDAIR. We feel the aircraft start to go out of control and we fight the controls to get it back but they don't seem to work the way they should. We can't remember what to do as terror has made our minds a blank. We remember all those things that he said were okay and that we should have said something about because we knew better.

In slow motion we look at the altimeter and think that if we keep losing altitude it won't take long to get to the ground. We feel like we're upside down but we aren't sure as we are having trouble seeing the instruments. We are being forced down in our seats as the aircraft starts to spin. We wonder if our old instructor will hear about this and if he will think it was our fault that we were killed. Then we start to scream as the realization dawns on us that we are going to die. Terror takes over every fiber of our body and mind as the thought strikes home.

As the flames consume what is left of the wreckage, it makes a fitting memorial to "the way we were."

Flying a helicopter into icing conditions can be a tricky business at best; but when we do so without adequate knowledge concerning its effects, disregarding directives and cautions stipulated in AR 95-1 and in the Operators Manual, we may find we are literally . . .

USAAAVS

Ted Kontos
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WALKING A TIGHTROPE

FOR NEARLY AN HOUR the twin-engine, single-rotor, multi-bladed helicopter had been churning along at 8,000 feet msl in areas of high humidity. While the outside air temperature varied en route, the maximum noted was +5° C. The pilot began a descent and approximately 5 minutes later leveled the aircraft at 5,000 feet. Shortly afterwards he descended to 3,000 feet. The aircraft was then seen making a normal turn when unusual noises were heard and the main rotor blades were noted coning upward.

Rotor rpm decreased and one blade separated from the rotor head. The aircraft nosed over into a vertical position and more blades departed. The helicopter continued to descend uncontrollably until it crashed to the ground, exploding into flames. All crewmembers and passengers were killed on impact.

Bit by bit, accident investigators pieced the events that led to the accident. Conditions favorable for the formation of induction ice existed along the flight route, and the aircraft had been subjected to these conditions for nearly an hour before it descended into warmer air. During this time, induction ice had formed and accumulated in the particle separators. The warm air encountered during descent caused the ice to partially melt and dislodge. The amount of ice dislodged, was sufficient to cause catastrophic damage to the compressors of both engines, resulting in a total loss of engine power, a rapid decay of main rotor rpm and blade stall. Because of the rapid sequence of events, the pilot was not able to detect, analyze and take corrective action in time to prevent excessive loss of rotor rpm and coning of the main rotor blades. Components then failed, blades separated from the rotor head, and the helicopter entered an uncontrollable vertical descent to the ground.

This recent catastrophic accident serves as a grim reminder that while the helicopter is a most ingeniously engineered vehicle, capable of performing feats impossible with fixed wing types, it is much more adversely affected by external factors than they are. Consequently, stringent controls must be exercised during helicopter operations based not only on the capabilities and limitations of the individual pilot but especially on those of the aircraft.

For years, icing has been recognized as one of the most critical problems affecting safe helicopter operations. The most obvious reason is that Army helicopters, for the most part, are not equipped with adequate icing protective systems. Secondly, the helicopter is more adversely affected by prevalent icing conditions than is its fixed wing counterpart. In addition, because of inherently different aerodynamic characteristics of the helicopter as compared with fixed wing aircraft, icing forecast methods currently being used do not predict icing intensities as accurately or adequately for helicopters as they do for fixed wing aircraft.

As a matter of fact, the primary cause of helicopters encountering icing conditions that exceed their capabilities is suspected to arise from inaccurate icing forecasts. Data accumulated by the U.S. Army Agency for Aviation Safety (USAAAVS) indicate that most icing encounters occur during cruise flight at altitudes of 1,500 to 6,000 feet. Based on the assumption that pilots rarely deploy intentionally into forecast icing conditions, and even less frequently into forecast icing conditions greater than trace or light, the USAAAVS data certainly implies that forecasting accuracy for helicopters is less than adequate. This data is further substantiated by operational units themselves.

The need to observe directives and cautions concerning helicopter flight in icing conditions as well as to understand the accumulation and effects of ice on the helicopter is essential to the safety of aircraft occupants and equipment.

To begin with, AR 95-1 states that Army aircraft will not be flown into known or forecast *severe* icing conditions. If a flight is to be made into known or forecast *moderate* icing conditions, the aircraft must be equipped with adequate deicing or anti-icing equipment.

A check of the Operators Manual (-10) of a specific Army helicopter, the UH-1, provides the following information: "The helicopter is provided with the necessary instruments and navigation equipment to accomplish missions under *operations including light icing conditions.*" The dash 10 further states: "Before entering icing conditions (visible moisture and below freezing temperature), the pilot should activate the pitot heat, windshield defroster and deicing system and *observe the following caution*":

"CAUTION"

"When operating in an outside air temperature of 40° F. or below, icing of the engine air inlet screens can be expected. Ice accumulation of the inlet screens can be detected by illumination of the engine inlet air caution light. Continued accumulation of ice will result in partial or complete power loss. It should be noted that illumination of the engine inlet air caution light indicates ice [illegible] ge at the inlet screen only and does not reveal icing conditions in the particle separator or on the FOD screen. Continuous flight in light icing conditions is not recommended because the ice shedding induces rotor blade vibrations, adding greatly to the pilot's work load."

Concern was expressed by DA, based upon field complaints, about the capabilities of current helicopters to safely operate in an icing environment. To determine this capability, artificial icing tests of the UH-1 helicopter were conducted in Alaska beginning in September 1973. Natural icing tests were conducted at Fort Lewis, WA, in February 1974. The tests showed that artificial icing characteristics are representative of natural icing. Some important findings are as follows:

Performance. Generally, a power setting of 25 psi torque was required to stabilize at 82 KIAS level flight outside the cloud. There was no apparent increase in torque requirements while icing the fuselage only. However, when icing the rotor system only, torque requirements did increase proportionally with ice buildup on the main rotor blades. An additional 6- to 9-psi torque above that required for level flight corresponded roughly to one-half to three-fourths inch of ice measured on the leading edge of the rotor blade after landing. The helicopter was not power limited at the desired test conditions. Increasing torque requirements to maintain constant airspeed and altitude during flight into icing conditions is the best indicator to the pilot of degraded level flight performance.

Fuselage icing. The portions of the test aircraft which were most susceptible to ice accumulation were the nose, skids and cross tubes, exposed antennas, exposed rotating and nonrotating parts of the main rotor system, and the outside sections of the synchronized elevator. Heat from the engine exhaust prevented ice from accumulating on the inboard portions of the elevator.

Engine inlet icing. In-flight photos of the UH-1 helicopter after exposure to natural icing showed that the left engine air inlet screen accumulated significant amounts of ice, while it appeared that the upper screen was free of ice. However, during the artificial test, no ice was reported on the screens.

FM antenna. Ice buildups on the FM antenna mounted on the vertical fin caused unstable antenna motion resulting in tail rotor strikes and splitting of the FM

antenna. The test aircraft was not modified with MWO 55-1500-200-20/6, 5 February 1968.

Visibility. It was found that the windshield and chin bubbles rapidly ice over, restricting all forward visibility. The installed UH-1 windshield defog system was activated but was unable to clear the windshield. Even when the defogger was used to preheat the windshield prior to entering the icing cloud, it was unable to keep the windshield clear of ice.

Main rotor icing. Flying in various icing conditions resulted in ice accumulation on the fuselage which conformed to FAA icing severity definitions (trace, light moderate and heavy icing). However, the ice accumulation on the main rotor system did not conform to those definitions. A flight was programmed under light icing condition (artificial test). One-fourth inch of ice was accumulated on the visual probe, conforming to FAA light icing definitions. After landing, seven-eighths inch of ice was measured on the leading edge of both main rotor blades approximately 9 feet from the hub, indicating that the rotor rotation amplifies ice accumulation.

Ice shedding characteristics. For all test conditions, ice shedding from the main rotor did not result in ice striking the fuselage or tail rotor. At temperatures of -4° C. in light icing conditions, ice was generally shed symmetrically by the main rotors from the blade tip inboard to approximately 9 feet from the rotor hub. At temperatures of -9° C. in light icing, asymmetric shedding was encountered.

The worst condition was at -9° C. following accumulation of an estimated three-fourths inch of ice on the main rotor blades. One blade suddenly shed ice while the other blade retained all its ice. Severe vertical vibrations followed, making cockpit instruments unreadable. The asymmetric condition persisted for 7 minutes and not until the aircraft had reached lower altitudes and -5° C. temperatures did the rotor shed ice again and attain a symmetrical ice loading. Because of the possibility that deliberate control inputs may cause asymmetric rotor blade ice shedding, it is *cautioned* that this procedure not be employed.

Ice was shed while passing through translational lift during the approach to land, as well as at touchdown. Pieces of hard clear ice shed by the main rotor were found at distances up to 300 feet from the aircraft on several occasions.

Autorotation. A 6- to 9-psi torque increase was noted after 10 to 15 minutes of flying in programmed icing conditions. It is estimated that a buildup of three-eighths to one-half inch of ice is sufficient to cause the observed torque pressure increases. With these indicated torque increases it was not possible to maintain minimum operational rotor speeds during autorotation.

Recommendations. When a 5-psi torque pressure increase is required above the cruise torque setting used prior to entering icing conditions, the pilot should exit the icing environment as soon as possible. Where torque pressure increase exceeds 5 psi, it may not be possible to maintain autorotational rotor speed within operational limits, should an engine failure occur.

Severe vibrations may occur as a result of main rotor asymmetrical ice shedding. If icing conditions are encountered while in flight, control movements should not be made in an attempt to remove ice accumulations from the main rotor blades. If asymmetrical ice shedding should occur, the aircraft should be flown to a warmer flight level, if possible.

Ground personnel should remain well clear of helicopters during landing and shutdown after flight in icing conditions. Passengers should not depart the helicopter until rotor blades have stopped.

Pilots should be informed that weather forecasters will give icing severity based on meteorological conditions as they affect fixed wing aircraft. Helicopter main rotor blade rotation amplifies ice accumulation.

The right and left engine air inlet screens should be removed before flight into forecast icing conditions. Keep in mind that this action nullifies the engine air inlet warning light system.

If freezing rain is encountered in flight, the pilot should land if possible. When it is not possible to land, the pilot should request a higher altitude if IFR, or if VFR initiate a climb and contact the nearest ATC facility requesting clearance. Freezing rain is usually the result of a warm air mass overriding a cold air mass. If the pilot climbs when he encounters freezing rain, he will normally be entering warmer air.

On 3 January 1975, representatives from USAREUR Headquarters, V Corps and the 11th Aviation Group met at VII Corps to discuss problems relative to icing and its effects on helicopter safety. One result of this meeting was the drafting and subsequent approval of the following interim change to be incorporated into the USAREUR supplement 1 to AR 95-1:

INTERIM CHANGE TO USAREUR SUPPLEMENT 1 TO AR 95-1

Message, 291312Z Apr 75, from CINCUSAREUR, Heidelberg, Germany.

USAREUR Suppl 1 to AR 95-1 is changed to add: page 4-5, par. 4-22, required equipment.

(Added) g. Aviators flying rotary wing aircraft without control surface deicing/anti-icing equipment may file flight plans for flight into forecast icing conditions if one or more of the following conditions apply:

(1) The tops of low and middle level clouds will be at or below 8,000 feet.

(2) At flight level, the flight will be in and out of clouds.

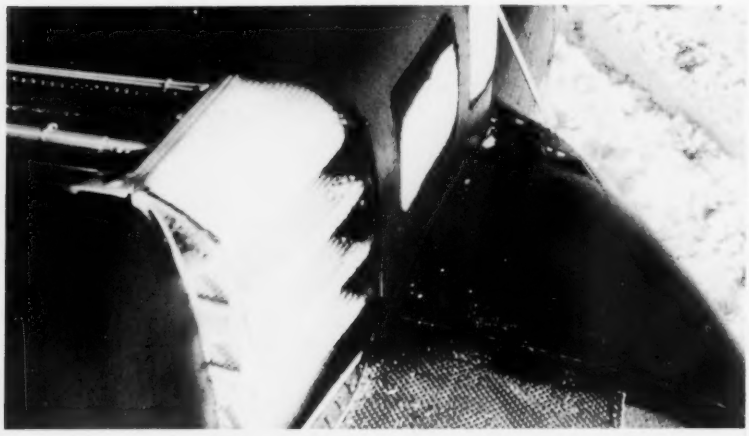
(3) A minimum en route ceiling of 1,000 feet.

The only exception to this policy will be for a mission of an emergency nature.

Common weather hazards encountered during winter helicopter operations include low ceilings, fog, blowing snow, wind and severe turbulence. Each poses its own threat to flight safety; but when coupled with icing problems, the pilot's position becomes much like that of a professional tightrope walker. The acrobat may know his business and be able to perform brilliantly while balanced precariously above the ground. However, the number and types of maneuvers he can perform are limited and one mistake—one slip—can send him tumbling downward. And, unlike the acrobat, the pilot has no safety net beneath him to check his fall.

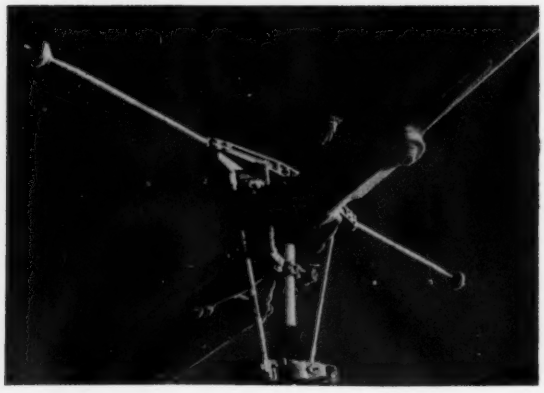
Knowing his own capabilities and limitations as well as those of his helicopter; understanding ice formation and its effects; obeying pertinent directives and cautions together with a determination to avoid unnecessary risks make up the best insurance package a pilot can presently obtain against the hazards associated with ice.

Why not sign up for a policy now? No examination is required and there are no premiums to pay. You may never need it; but if you should, it may be just the thing to keep you from suddenly finding yourself in the unenviable and frightening predicament of "walking a tightrope."



We had three-fourths inch to one inch of solid rime ice on the leading edge of the main rotor, the air intake screens were almost completely frozen over, and the tail rotor had a good one-half inch of rime on its leading edge.

SEVERE CLEAR



AS I STEPPED out of the house I felt a sharp, stinging sensation. The air left a burning, scorched feeling deep down in my throat and instantly froze my eyelashes, the hair at my temples and the hair in my nose. It was pitch black with no visible horizon. The stars flickered brightly and lights of the city twinkled. There was every indication this was going to be another super-cold, "severe-clear" day, found only in the Alaskan winter. It was such a beautiful morning it was almost worth getting up two hours early just to help preheat and warm up the U-8.

On my way to the field the sun slowly began to

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CW2 Jon L. Osgood USAAAVS

rise, casting soft hues of pink and purple along the tops of the mountains. Like the white water of a mountain stream, steam swirled wildly from car exhaust pipes. I noticed a few patches of low-lying ground fog. Even though it was cold outside I felt warm inside and I was truly happy to be alive.

Pulling up to operations, I noticed our crew chief's car and hoped he had already hauled the Herman Nelson heater out to the aircraft. The air was still and dry and snow cracked and popped under my feet as I walked toward the hangar.

Thinking about a friend of mine who had a Jet Ranger blow up in his face during refueling because of improper grounding, I started mentally sorting out all the precautions we would have to take—a good solid ground while refueling, a sufficient warm-up period and a thorough runup, checking all systems with meticulous care. No need to worry; we had plenty of time and we knew what we were doing.

I found our crew chief in the hangar. He turned when he saw me walk in.

"Sorry, Jon. It seems we loaned out the only two good heaters we had to the Army. They have all their Hermans on a field exercise."

"Now that's just fine! There's no way we can move these three Hueys out and move the U-8 in and get it warmed up enough for a 0730 takeoff. We'll just have to plug an APU into the U-8 and use the preheating ducts installed in the fuselage."

The APU worked fine but all we could get out of the Janitrol heater was cold air. I was running out of time and patience. "Well, I'll try the spare ignitor up in the nose wheel well, and if that doesn't work . . ."

Trudging across the snow toward operations, feeling frustrated and flustered, I was finding it difficult to think of a cheerful greeting for the general. How could I diplomatically explain to him that we had tried everything but had just become victims of circumstances beyond our control?

What had begun as a beautiful morning suddenly became very gray and gloomy. Ground fog started creeping through the housing area, slowly moving toward the airfield. It was only 30 to 40 feet high and it looked very eerie. It was strange to see the tops of several telephone poles and one American flag sticking out a dense blanket of fog.

I walked into operations and got on the phone. Elmendorf Air Force Base told me everybody else was CAVU and that he thought we were. The weatherman said our fog patch had to be small and that it would move on in a few minutes. Colonel Weidman had already received "dash one" weather for our flight and it was indeed "severe clear" every place except right on Bryant Army Airfield.

The door to operations opened and in walked the general. Hurriedly, I explained why our takeoff was delayed. I was quite relieved when he smiled and said, "That's okay. I wanted a second cup of coffee anyway."

"Sir," I said, "the trip may take a little longer but we can take you in a helicopter."

"That's fine," he replied. "No big rush. I'll be over in the hangar. I would rather get there an hour late than not at all."

I suggested to Colonel Weidman that he stay with the general while I preflighted the helicopter. But he didn't want to appear idle so we both wandered off into the fog looking for 524.

It was so cold (-20° C.) that when I opened the pilot's dash 10 checklist the cover snapped right off. The fog was really dense on the ground. Up on the head of 524 I could almost see blue sky. We gave it an extremely thorough preflight and I suggested we check battery voltage to see if we would need an APU.

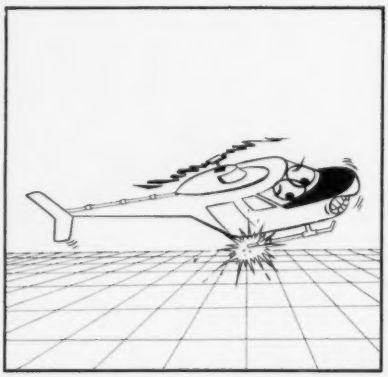
We decided to go ahead and warm it up and make sure all our checks were good. We didn't want any more delays once the fog moved on.

We had a normal start and the aircraft was idling smoothly at 70 percent N1 while we were waiting for temperatures to rise. Suddenly, I felt a severe vibration coming from the tail rotor. The aircraft began to shudder violently and I instinctively hit the idle cutoff button, rolling the throttle off. The main rotor came to a stop much faster than normal and as I looked up at the blade I realized immediately what I had done. In my rush to make up for the frustrating delays I had failed to consider something basic. I had neglected to correlate the temperature with the fog. I knew better than to try to fly in ice-fog. Nobody in Alaska is that stupid. We weren't going to fly until the fog lifted. All we were doing was warming up the aircraft.

The fog moved on as rapidly as it had appeared and the sun was so bright it hurt my eyes. I was extremely fortunate in that my pride was the only other thing hurt. We had three-fourths inch to one inch of solid rime ice on the leading edge of the main rotor, the air intake screens were almost completely frozen over, the mast and controls on the head were covered with ice and the tail rotor had a good one-half inch of rime on its leading edge.

Walking back to the hangar, I couldn't help but wonder what would happen if I allowed myself to become distracted on an IFR flight and unknowingly flew into similar atmospheric conditions.

briefs that teach



tired pilot

After completing a night training operation, an OH-58 crew was asked to transport two ground guides back to home base. Arriving at the airfield, the pilot was cleared to land. He completed his approach and requested hover instructions. While hovering to the parking area, the pilot allowed the heel of the right skid to strike the ground during a left turn, resulting in a roll to the right. Two of the occupants sustained major injuries.

Fatigue is a suspected factor in this mishap. **The pilot had been awake 16.8 hours and had just completed a series of landings at a tactical landing field in a location with very few ground reference lights.** Disorientation is a probable factor. The pilot was subjected to extreme light changes and a partial loss of dark adaptation.

two tired pilots

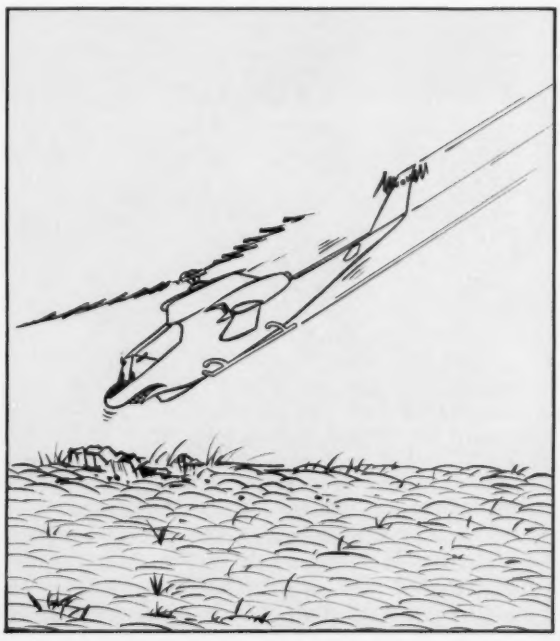
A noncurrent instructor pilot (IP) and a newly trained AH-1G IP were on an IP proficiency training flight. The noncurrent IP needed the flight to prepare for a standardization instructor pilot evaluation checkride scheduled for the next day.

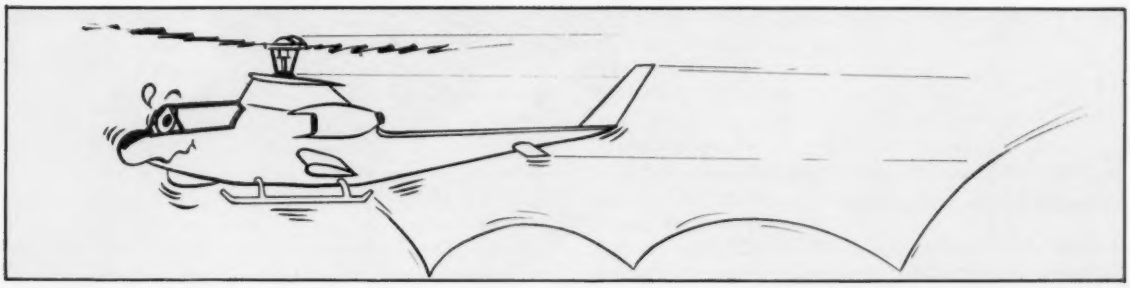
After performing tactical maneuvers, the pilot (noncurrent IP) and IP flew to the airfield to practice emergency procedures. The pilot entered a straight-in autorotation to an intended touchdown. At 75 to 100 feet altitude, he initiated a moderate deceleration to slow his rate of descent. Failing to slow his descent substantially, he applied additional aft cyclic, increasing his deceleration attitude to approximately 25 degrees. At about 15 feet, with a continued high sink rate, he made an initial pitch application. At this point the IP joined him on the controls, intending to level the aircraft. Complete forward cyclic and full pitch application came after the initial impact. The pilot and IP were injured and the aircraft was destroyed.

The IP and pilot were performing touchdown autorotations under less than desirable conditions. The IP's failure to recognize a hazardous situation in time to recover can be attributed to his depressant physical condition and fatigue.

The pilot failed to correctly judge aircraft altitude. **This error in judgment and timing can be attributed to fatigue and pressures from supervisors to accomplish the mission.**

There were no standard operating procedures or supervisory controls to ensure that aviators were not physiologically or psychologically overtasked. **(See "Fatigue," page 28 of this issue.)**





hard look

An instructor pilot (IP) and student pilot (SP) flew a TH-1G to a stagefield where the IP demonstrated steep approaches and maximum performance takeoffs and let the student practice the maneuvers. The IP talked the SP through an autorotation, terminating with power, before attempting a touchdown autorotation.

During the touchdown autorotation, the SP applied excessive cushioning pitch, causing the aircraft to ascend to 8 to 10 feet with low rotor rpm. The IP was late with corrective action when he attempted a power recovery and the aircraft touched down hard, bouncing from a nose-low to a tail-low attitude.

The IP then hovered to the parking area to calm himself and the student. Without shutting the aircraft down, the IP exited and made a visual inspection. Continuing the flight period, he demonstrated another autorotation and then returned to the airfield.

When the IP conducted the postflight inspection he noticed a crack in the 90-degree gearbox fairing and notified maintenance. He later talked to a unit standardization instructor pilot about the possibility of a hard landing and was told to write up a possible hard landing on DA Form 2408-13.

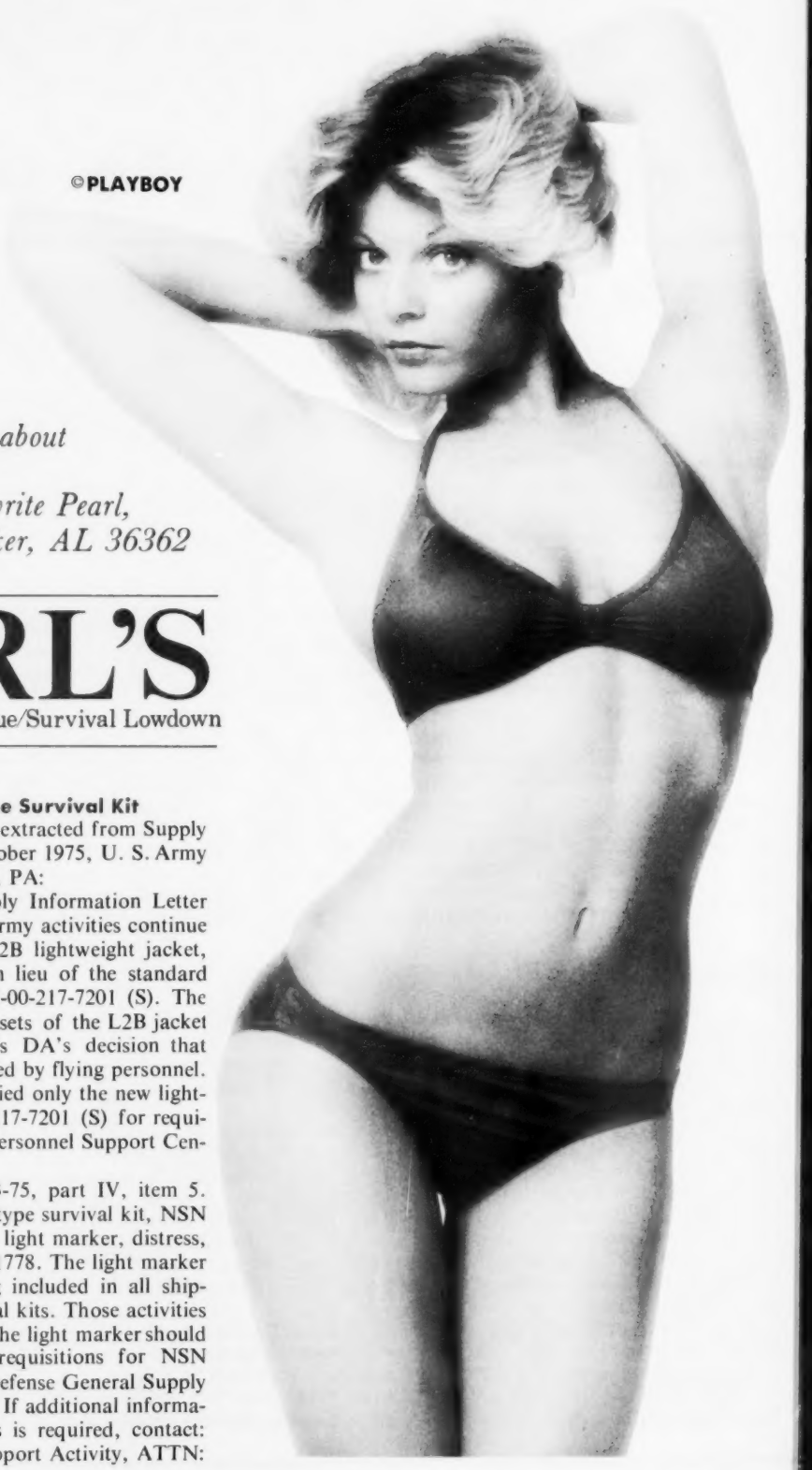
The aircraft should not have been moved after the hard landing. The IP said he did not suspect a hard landing because he had been able to partially cushion the landing. **However, it just makes good sense to thoroughly inspect your aircraft before further flight after any unusual landing.**

stumped

On final approach to a pickup zone, the pilot of a UH-1H noticed numerous stumps in the area. After planning his approach to miss all visible stumps, he brought the aircraft to a hover and the crew chief cleared him down to the ground, which had 12- to 13-inch grass covering the entire area.

As the aircraft settled to the ground, the pilot noticed that the attitude was not normal so he stabilized the helicopter with power applied and remained light on the skids. Personnel then began boarding. The crew noticed a shift in the position of the aircraft and heard a muffled crunching sound coming from the underside. The pilot told the crew chief to get out and inspect the underside of the aircraft. The crew chief saw the stump and the pilot got out and inspected the damage. No fuel leakage was apparent so the pilot decided to continue the mission (a violation of AR 95-5).

This pilot did not fully use his crew in clearing the landing area. Supervisory error was also a factor. **The company commander failed to properly supervise the preparation of the landing zone and 11 stumps at least 18 inches tall were left in the area.** Small trees in landing areas should be cut flush with the ground to reduce hazards to helicopters.



USAAAVS

If you have a question about personal equipment or rescue/survival gear, write Pearl, USAAAVS, Ft. Rucker, AL 36362

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Flyer's Jackets and Vest Type Survival Kit

The following material was extracted from Supply Information Letter 5-75, 1 October 1975, U. S. Army Support Activity, Philadelphia, PA:

Reference is made to Supply Information Letter (SIL) 2-75, part III, item 4. Army activities continue to requisition the replaced L2B lightweight jacket, NSN 8415-00-917-0597 (S) in lieu of the standard lightweight jacket, NSN 8415-00-217-7201 (S). The Army's portion of residual assets of the L2B jacket has been exhausted and it is DA's decision that the Nomex type jacket be used by flying personnel. Army customers will be supplied only the new lightweight jacket, NSN 8415-00-217-7201 (S) for requisitions submitted to Defense Personnel Support Center (DPSC).

Reference is made to SIL 3-75, part IV, item 5. DPSC was supplying the vest type survival kit, NSN 8465-00-177-4819, without the light marker, distress, SDU-5/E, NSN 6230-00-938-1778. The light marker is now available and is being included in all shipments of the assembled survival kits. Those activities who received the kits without the light marker should submit funded MILSTRIP requisitions for NSN 6230-00-938-1778 directly to Defense General Supply Center, routing identifier S9G. If additional information pertaining to these items is required, contact: Commander, U. S. Army Support Activity, ATTN:

STSAP-C, 2800 S. 20th Street, Philadelphia, PA 19101.

Underarm Life Preservers

Over the past year, our facility has received 50 LPU-10/P underarm life preservers which were not modified in accordance with USAF T. O. 145-1-102 (1 Jun 72) with changes through 5, dated 1 Mar 75. The T. O. specifies two modifications:

- *Stitching lanyard sleeve or safety-tying knob to container (par. 12-28.)*
- *Installation of hook and pile tape cell connectors (par. 12-40). All pertinent instructions and diagrams are included in the T. O. But since we do not have trained life support equipment (LSE) specialists, whose job is it to maintain, inspect and repair LSE? The facility has more than 150 flight crewmembers who are authorized LSE (i.e., life preservers, liferafts, survival vests, hot and cold weather survival kits, to name a few). Has USAAAVS addressed the possibility of training life support specialists similar to the Air Force?*

Our facility has a mutual assistance program with the Air National Guard who has MOS trained life support specialists, but most aviation safety officers are not that lucky.

At the present time, the commander is charged with the responsibility for maintaining, inspecting and repairing aviation life support equipment within the guidelines of appropriate publications. Technical Manual 55-1680-317-23 & P, dated 8 August 1975, entitled "Organizational and DS Maintenance Manual Including Repair Parts and Special Tools List for Army Aircraft Survival Kits," and Technical Order 14S-1-102, "USAF Flotation Equipment," provide instructions for personnel responsible for performing organizational and direct support maintenance on Army aircraft survival kits.

U. S. Army Troop Support Command message 092144Z, October 1975, denotes which of the above publications to use in maintaining the different types of flotation equipment. The contents of this message were published in *FlightFax*, Vol. 4 No. 7, dated 19 November 1975. Further information concerning flotation lifesaving equipment used in Army aircraft may be obtained from Commander, U. S. Army Troop Support Command, ATTN: AMSTS-MMM-3, St. Louis, MO 63120 (AUTOVON 693-2472).

USAAAVS has recognized the need for and addressed the possibility of training life support specialists similar to the Air Force. At the present time, a proposal is under consideration at DA which would establish an aviation life support equipment career management field.

You are to be commended for the actions of your unit in negotiating a support agreement with the Air National Guard.

Identification Tags

Identification (ID) tags worn around the neck can be dangerous during preflights, emergency exit, etc. So I have encouraged pilots in my unit to wear them in the left breast pocket. I would appreciate your viewpoint on this matter.

Paragraph 78, AR 606-5 with change 10, prescribes use of ID tags. In addition to a requirement for wear when traveling in aircraft, ID tags are required for mandatory wear outside CONUS. Paragraph 80 prescribes the method of wear, i.e., suspended from the neck, etc. Paragraph 84 discusses the importance of these tags in the identification of the dead.

It is doubtful that the issue "chain" would impede emergency egress from an aircraft or cause serious injury in the aviation environment. This is because of the construction of this "chain" and the relative ease with which it may be broken.

It is recognized that ID tags could become a possible source of FOD when working around aircraft. However, this Agency has no record in our data base of ID tags being a cause related factor in an Army aircraft accident.

If your unit is having problems complying with AR 606-5, recommend you submit DA Form 2028 (Recommended Changes to Publications) with complete justification to the proponent agency. If you select this course of action, request you furnish Commander, USAAAVS, ATTN: IGAR-TA, Ft. Rucker, AL 36362, a copy of your recommendation.

Lifesaver Survival Firestarter

I recently was given a lifesaver survival firestarter, NSN 9920-00-999-6753, by a retiring CW2 in my troop. When adjusted to full open, the flame is about an inch high. However, I cannot find anyone who knows the proper way to refill the firestarter. If there is a special adapter, would you please furnish the NSN.

The lifesaver survival firestarter was purchased by the Army and is considered to be in the expendable category. As a result, an adapter for refueling was not purchased and is not available. The company which manufactured and sold this item to the Army no longer is in business. There are still stocks available for issue. The unit cost at this time is $4.15.

USAASO Sez

Don't Flip Your Blip—Hawk Your Squawk!

A MAJOR AND oft recurring problem has arisen in the air traffic control (ATC) arena since the beginning of the automated mode of operation in both center and terminal radar facilities. The computers are programed to identify the assigned discreet transponder code of a departing aircraft. If a pilot fails to turn his transponder on or select the correct code the whole system goes "Tilt." The normal ATC facility method of catching this is when the pilot first calls departure control on the audio. Unfortunately, there have been instances when an aircraft had departed without an operating transponder and didn't squawk or for various reasons the pilot also failed to communicate. One Federal Aviation Administration report concerns an air carrier out of San Francisco that was not identified until over Stockton at FL 230. Couple that situation with no primary (skin paint) radar return and it could make for some hairy situations.

The majority of the problem seems to be with other aviation operators. Let's keep it that way. To keep from flipping your "Blip" the following actions are recommended.

- Pilot and copilot confirm in the cockpit the correct transponder code setting.
- Use your dash 10 checklist which provides a positive check for turn on of transponder line up check.
- Make sure communications are established with departure control and that, in fact, they are talking to you.

Aviators' Specialty Selection Underway

MILPERCEN—Military Personnel Center—has started to identify commissioned aviators to be considered for redesignation into aviation, specialty 15—the newly approved OPMS advanced entry specialty. Records of about 5,500 aviators with at least 7 years active commissioned service as of 30, June 1975 will be reviewed.

Once these aviators' records have been reviewed, Officer Personnel Directorate career divisions will determine tentatively the combination of OPMS (Officer Personnel Management System) specialties considered best for future designation. During March, each aviator will be advised by letter of the tentative designations and will be asked to agree—or list alternate preferences. These factors will be considered by the board in making the final designations.

By the end of June, commissioned aviators will be informed of the two specialties in which they should expect future management.

Once redesignated into the aviation specialty, officers will be managed in aviation and one other OPMS specialty. Those not selected for the aviation specialty will continue to be managed in their currently identified alternate specialties.

Since OPMS primary and alternate specialties have been designated for all rated officers in year groups 1968 and earlier, those selected for the new aviation specialty will have to substitute it for one of their two currently designated specialties.

Redesignation into the aviation specialty depends on:

- Army requirements
- Utilization standards under the Aviation Career Incentive Act
- Experience and potential in all specialties under consideration
- Year group strength requirements
- Officer preference for aviation specialty designation

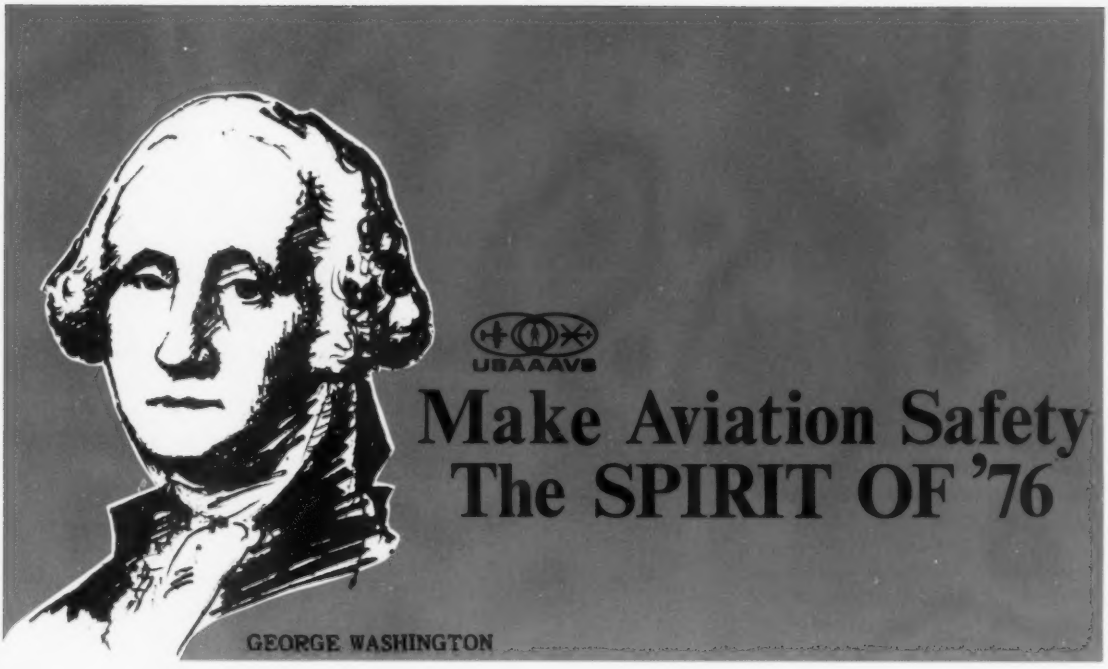
Projections based on the current number of aviators and training rates indicate many field trade aviators will be redesignated into the aviation specialty. Current projections also indicate that about 50 percent of the eligible captain aviators from the aviation overstrength year groups 1966-1970 will be designated into the specialty. Virtually all aviators in year groups 1972 and later will be designated into aviation at the 8-year point.

All aviators, including those involuntarily precluded from having aviation as one of their OPMS specialties, will be entitled to continuous monthly flight pay for the first 12 years of aviation service if they pass an annual flight physical and writ—and do not request indefinite suspension from flight status.

Although no aviator can be guaranteed of making pay gates beyond the twelfth year of aviation service, those selected for the aviation specialty will have the best opportunity of meeting the gates since they will be managed into positions calling for qualified commissioned aviators.

Some officers—especially in the combat arms—selected for the aviation specialty will have to give up a branch-related specialty in which they already are considered proficient. However, their officer record briefs (ORB) will be annotated to reflect they have attained sufficient experience in the previously designated specialty to be considered for assignment in job related areas. They also would be eligible to seek command in the previous specialty.

The MILPERCEN redesignation action will have little impact on officers previously designated in the basic entry specialty of aviation materiel management—specialty 71. Medical Service Corps officers are not affected since they are not managed under OPMS.



"Derive useful lessons from past errors...profit by dear bought experience"

These words of George Washington, spoken 200 years ago, carry a meaningful message for today's aviation commanders and crewmen.

Our aviation safety programs are based on lessons learned the hard way—knowledge gained from "dear bought experience."

That we can benefit from the mistakes of others is well accepted, but the lessons learned sometimes appear to be forgotten too quickly.

In reviewing accident cause factors we recognize many similarities between occurrences, similarities which have appeared with enough regularity to cause some to feel there are no new accidents.

Obviously each accident results from an exclusive chain of events. Therefore, no two accidents are exactly the same. But accidents are often so similar that there is no doubt they would not have been repeated had preventive measures developed from past experience been applied.

Our job in aviation today is to "derive useful lessons from past errors"—to be constantly aware of the hazards which produce accidents and apply proven prevention measures. Our accident history is well documented. The lessons are there. By following Washington's logical reasoning we can make this history work for us.

MOBA

Article starts on inside front cover

The cover illustration depicts the constrained aspect of military operations in built-up areas. The enemy armor is forced down the street canyons. Once committed, he must press on to the next intersection. Buildings dominate his vehicle position. The accompanying infantry must provide cover to prevent attack on the tank's thin and vulnerable top. The attack helicopter gunner is taking maximum advantage, engaging the entire group in one ripple of 2.75 inch rockets with multipurpose submunition warheads. The pilot spends an absolute minimum amount of time exposed to air defense after leaving the cover on one side of the street—firing and recovering